Science WONDER Stories

February

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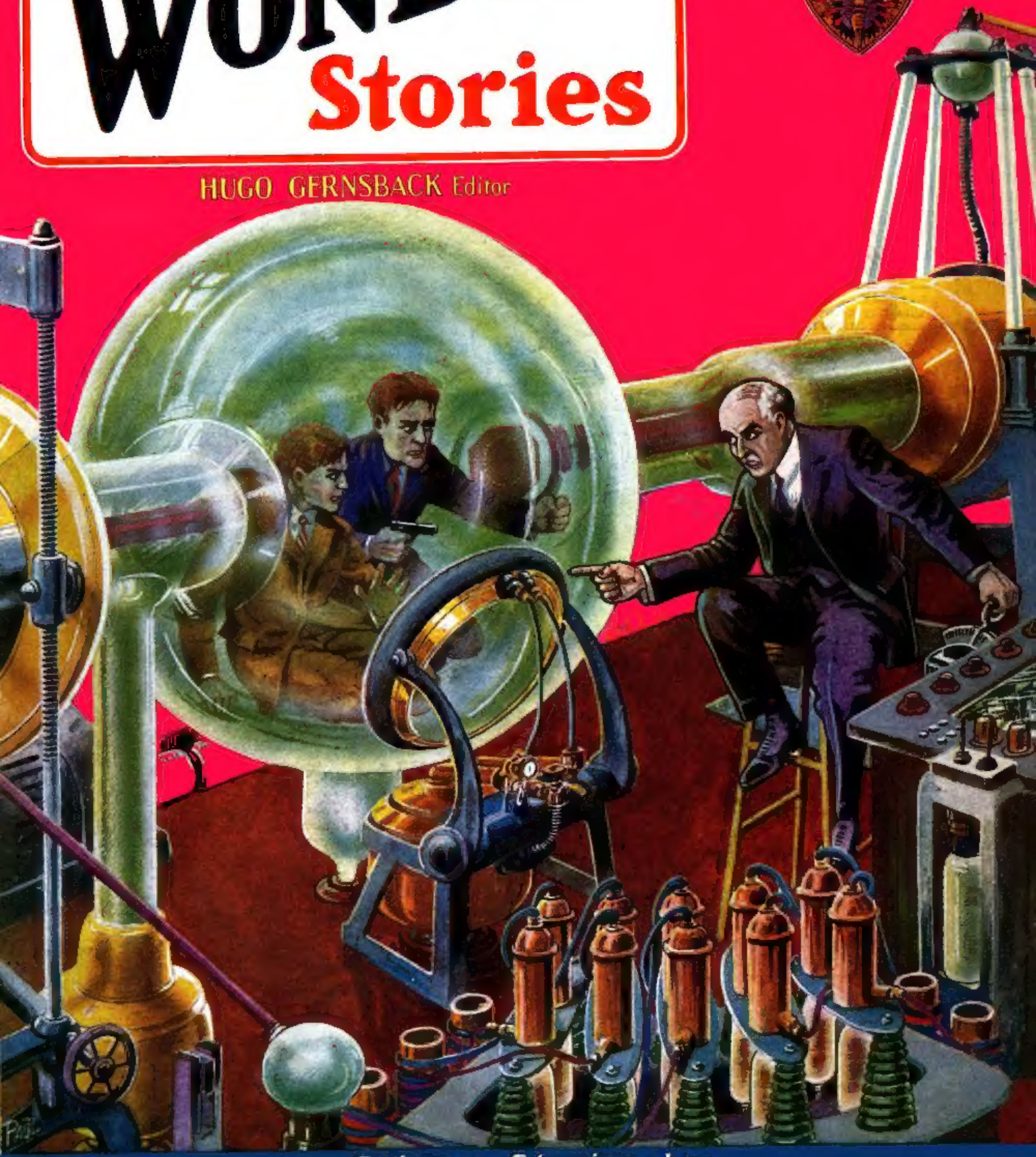

Science Stories by:

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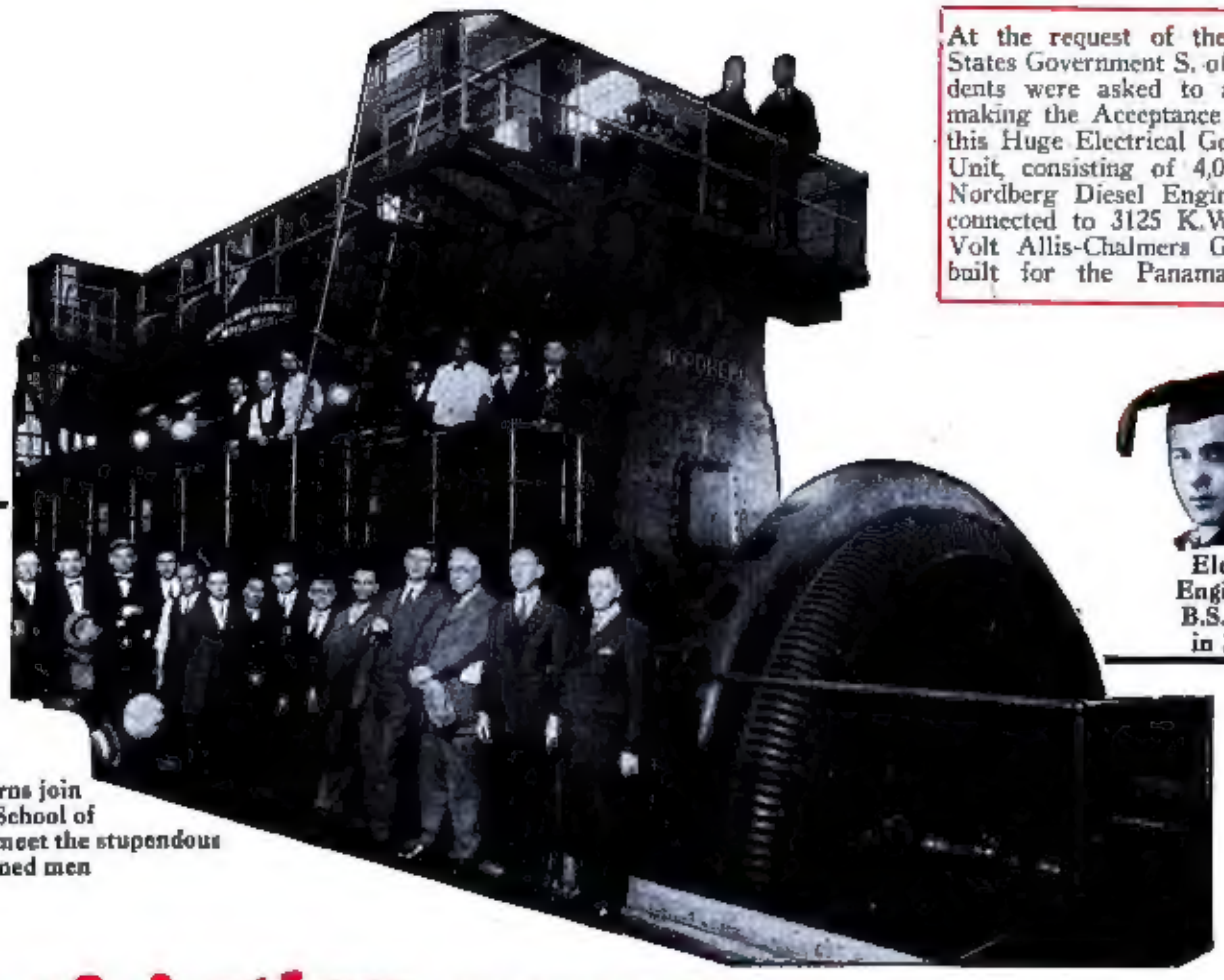

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Vol. 1, No. 9

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ON THE COVER

THIS MONTH is shown the druggist and scientist Sanborn ready to fling the two imprisoned criminals off to the land of the Bipos. Their attempt to shoot their way through the tube has failed.

NEXT MONTH

BEFORE THE ASTEROIDS, by Harl Vincent. Our popular and versatile author takes as the subject for his next story one of the greatest mysteries of our solar system. The well known Bode's Law—which explains mathematically how our planets came to have their size and their distance from the sun—shows that between the orbits of Mars and Jupiter there should have existed another planet. This gap in space has been filled by the asteroids, those minute planets 50 to 100 miles in diameter. How the asteroids came into existence, Mr. Vincent shows in a very thrilling interplanetarian story.

THE MYSTERY METAL, by Maurice and T. Howard James. It is not so long ago that the world was convinced that all chemical elements were indestuctible. The electron theory has quite upset this, and has given us the promise that we will be able to change the form of simple elements as we once changed the form of complex compounds. How this is done, our author shows very convincingly in an excellent mystery story.

PRIZE STORY NOVEMBER COVER CONTEST—The story adjudged the first prize for the best story written around the cover of the November 1929 Issue will be published in the March 1930 issue together with the winning author's picture. Over 800 manuscripts were received as entries, showing the remarkable interest of our readers. While we have not yet decided upon the winner, we know that some splendid writing talent has been uncovered among our readers. The other prize winners, together with the stories receiving honorable mention, which we will purchase, will be printed in subsequent issues.

A RESCUE FROM JUPITER, by Gawain Edwards. In the concluding installment of this masterful interplanetary story, Mr. Edwards takes a daring step into the future to show us what is likely to become of life on our planet. There are many curious things which have occurred in the first installment that are explained in a most unusual manner in the conclusion. With our greater and greater means of destruction, it is becoming more imperative that we exercise a proper control over our actions. Otherwise, the results will be, as Mr. Edwards points out, disastrous for the whole human race.

AND OTHERS.

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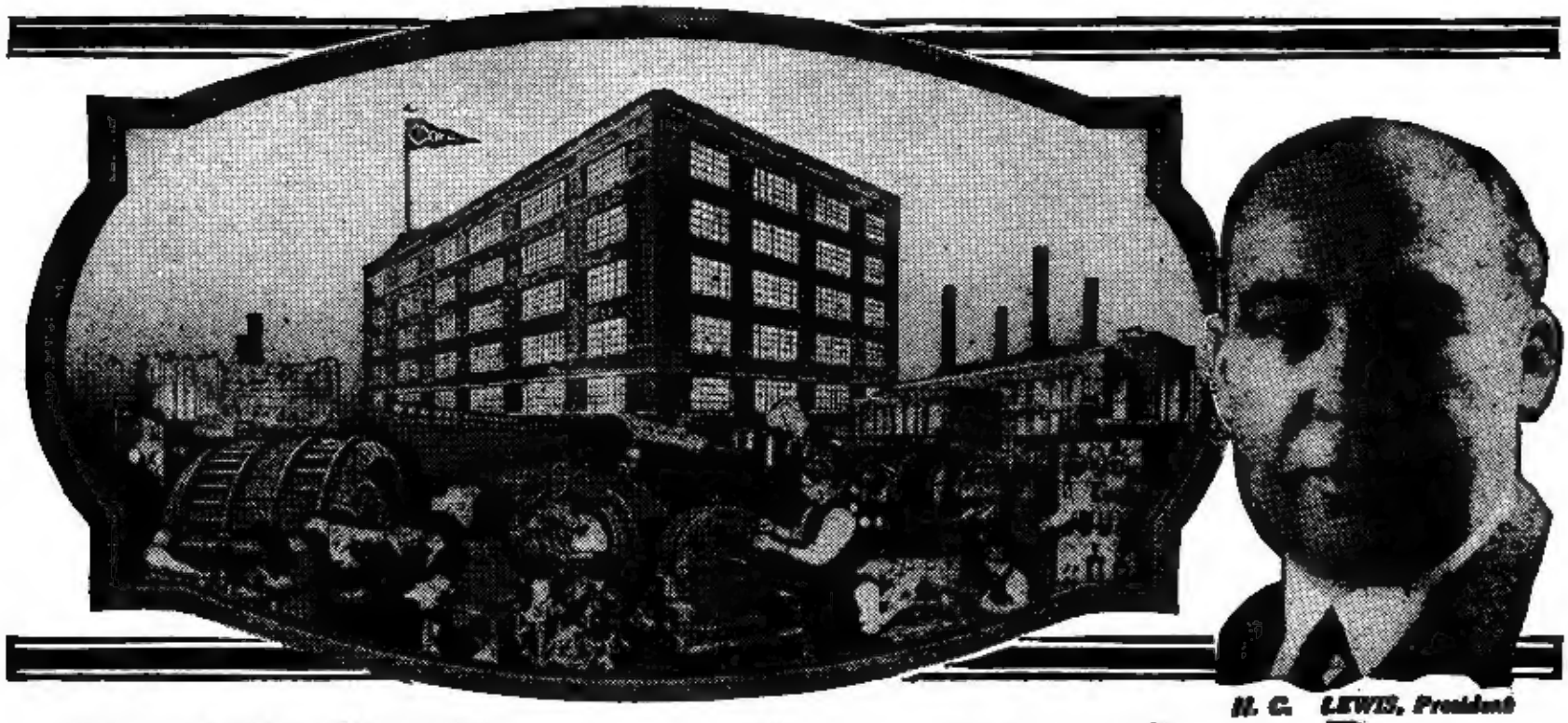

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1930

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These nationally-known educators pass upon the scientific principles of all stories.

CAN MAN FREE HIMSELF FROM GRAVITY?

By HUGO GERNSBACK

ELSEWHERE in this magazine is printed a symposium of the opinions of some of the world's greatest scientists on the possibility of space-flying, in conjunction with the problem of whether it will ever be possible for humanity to free itself from gravitation.

The arguments and evidence presented lead almost overwhelmingly to the conclusion that, as far as our knowledge of science extends at present, there seems to be little likelihood of man's freeing himself from the gravitational attraction of our planet.

But it should be noted, if one reads between the lines of the statements of the various authorities, that they are extremely conservative in their remarks and that few, if any of them, reject the idea as being entirely impossible at some future date.

It should be noted as important that there is a great difference between the problem of space-flying and that of the complete freeing of humanity from gravitation. The two have nothing to do with each other.

Nullification of gravity is considered, by many of the authorities, to be merely another word for perpetual motion. We are not certain that we care to accept this as final. While perpetual motion, no doubt, will remain an impossibility on earth, it is not such an impossibility away from the earth. If you take the sun and the planets revolving about it, you have almost an ideal perpetual-motion machine. Once set in motion, the planets have kept on revolving for millions and billions of years; and, though this may not be literally "perpetual," yet we may consider it such for all practical purposes.

But, although the nullification of gravity may not come about, this year or next—nor for the next hundred, or even for the next thousand years—sooner or later, some principle will be found to accomplish the feat. When the discovery is finally made, it will most likely be found that one does not get anything for nothing as opponents of gravity-nullification claim. In other words, it will require power to bring about the nullification of gravity. This, however, is not an insurmountable difficulty, any more than it is impossible for an airplane to defy gravity by means of its engine. This latter action, of course, is not nullification of gravity; and no sane physicist would believe that elimination of gravitation can be accomplished without the expenditure of energy. What the necessary expenditure of energy will be, no one can yet tell. You can take an ordinary bar magnet, weighing one pound, and permanently suspend two or three pounds from it. Perhaps gravity-nullification will have a similar solution.

The solution of the other problem, that is, space-flying, is not so far off; for, as Professor Goddard, the inventor of the rocket engine, points out in this issue, the problem has long ago passed its theoretical stage. Until a few years ago, scientific authorities were unanimous in the belief that it would never be possible for man-made engines to go beyond the immediate vicinity of the earth.

This is no longer the general belief; for it is realized that we may have the feat accomplished within ten years, and possibly much sooner. In this case, to lift a space flyer against the earth's gravitational influence, a tremendous amount of energy must be used; but, given this energy, the problem no longer presents insurmountable difficulties. Again it should be noted that, although present efforts take the form of rocket-flying, there is no reason for believing that no newer principles will not be found. New and more efficient methods will be devised in time. Just as the horse-drawn carriage was supplanted by the automobile, so in time the rocket engine will be supplanted by something more efficient in overcoming the earth's gravitational pull. We are just on the threshold of important discoveries. Only last year, Professor Einstein has shown that gravitation and electromagnetism are co-related. It seems, therefore, not a rash prediction that, sooner or later, we will be enabled to leave the earth in machines that will utilize purely electrical means of propulsion. In other words, gravitation itself may yet be overcome by the judicious use of electrical forces, applied in a manner that we can, as yet, conceive but dimly.

A Rescue from Jupiter

by Gawain Edwards

(*Illustration by Paul*)

"Then, while I poised there, the figure dropped its arm and, quick as a plummet, dropped through an opening and disappeared. I tried to leap forward and catch it; but the automatic mechanism was too quick."

A RESCUE FROM JUPITER

MOST of the evidence we now have seems to point to the fact that Jupiter, the giant planet of the solar system, is uninhabitable. Being over five times as far from the sun as from the earth, it receives over the same area one twenty-seventh of the light and heat that the earth does. But there is no doubt that our knowledge about Jupiter is almost insignificant. We have perceived through telescopes its equatorial bands. We have seen its nine moons; but there our knowledge of it stops. In the present story, our author indicates that Jupiter could be habitable in the future; and the reasoning on this seems quite logical and convincing.

But there is no doubt that the race of people that would exist there, even though they might be human, would have physical and mental characteristics influenced greatly by their environment. A hot, dry climate induces certain mental and physical reactions that are greatly different from those in an area which is cold or damp. This fact is already proved by the temperamental differences of the races that inhabit the globe, even though they are, as we believe, descended from practically a single stock. Our author has dealt with this subject very convincingly, and he has produced an interplanetarian story which is not likely to be soon forgotten.

WHEN the first explorers from the planet Jupiter, which they called P l e i d a reached the planet Tellus (which *its* former inhabitants had called Earth) they found there little to recommend it. Even at the first glance, it was obvious that Tellus was no longer habitable; if indeed it had ever known a race of intelligent beings. In the enormous o p e n areas which formerly were supposed to be covered with water, only tremendous dry fields of s a l t were found. Even at the poles, where enduring icecaps had once lain, there remained almost no moisture. Upon the arid backs of the former continents there was none; not even traces of former desert life could be seen. The earth was a sorry remnant of a world, unhappily dead before its time; a dry rock, wearily wheeling its age-old way around the sun.

The leader of the expedition from Pleida, Salvarius Carde, had found the journey to Tellus a long and dangerous one; and he did not desire to return without some definite proof, whether or not there had once been sentient life on the planet. Throughout the infancy of his own race, there had been a well-defined belief that intelligent beings, for many generations, had inhabited Tellus; there was, in fact, a Pleidan myth that people from Tellus had once visited Pleida in a protracted search for land suitable to human life. Though the surface indications of Tellus seemed to belie any tradition of life's having existed here, Salvarius Carde had ordered the eighty-nine men engaged with him in the exploration of the planet to scatter widely over its surface and to learn, if possible, whether there ever had been any inhabitants; and, if so, to seek also what had become of them.

Thereafter, for a third of the smaller planet's year, the envoys from Pleida had searched the surface of Tellus, their great white wings carrying them quickly here and there. The brilliant sun reflected from the mountains and deserts seamed with crystal salt, hurt their eyes; thirst turned them back again and again to their space-ship for new supplies of water. The seemingly utter uselessness of the quest caused many to urge repeatedly that it be given up; but Salvarius was a man of iron. He commanded them to cover all the planet; to miss not the least portion of its area; and to report all that they found.

It was only after many days had passed, at the time of year when the northern pole of Tellus tilts away from the sun, that Allus Marce, the most vigorous of the explorers, returned to the space-ship bearing in his strong hands a metallic cylinder of a dull color, evidently worn by the elements.

"I have found traces of the abode of man," he declared: "They are at the very bottom of what was once an ocean. Dying for want of water, these humans followed the receding moisture to the lowest place on the face of Tellus; and when the water disappeared, so did they. It was there I found this cylinder, which may contain writings; perhaps a history of this strange race."

"Were there other relics?" his captain asked.

"Many evidences of a once great civilization; traces of engines, long since oxidized away; stone walls still standing amid the dunes, glittering with crystalline salt like the endless hills."

"But no living beings?"

"None that I observed. There are no traces of cultivation; no water is left in the great salt lake which once lay in the hollow. I could not see how life could have continued to exist there."

"Tell me the circumstances of the finding of this cylinder; and why you believe it contains writings, though none appear on the surface of it."

GAWAIN EDWARDS

Marce's Story

ALLUS MARCE hesitated for breath before he replied. Then, facing his superior, he recounted how his search, conscientiously carried out, had taken him over illimitable deserts — waterless, and lifeless, without even the shifting caused by great winds to change the monotony of the landscape. At length, he had come abruptly upon a valley miles in length, and of a depth which marked it immediately as the lowest

spot on the surface of the planet. It was in the southern hemisphere, he explained, near the middle of what had once been the largest ocean of Tellus.

"Perceiving that I had here found a portion of the planet never before visited by men from our own world," he continued, "I entered into it cautiously, moving slowly, close to the surface of the ground, my eyes seeking continually for any trace of those lost man-beings which our lore tells us once existed here. The floor of this valley had once been level sea-bottom, and its walls were rocky cliffs, descending deep into the earth. But, as the water of the ocean had dried up, vast deposits of salt, deeper and of a clearer substance than any I had seen elsewhere on the globe, had covered the surface with a white and crystalline coat, reflecting the sun from countless facets until my eyes could hardly stand the glare. It was like entering a valley strewn with layers of the finest cut jewels. The sun's rays were reflected; multiplied, it seemed, a thousand-fold. And everywhere was eternal sterility. The deposits of crystal salts had fallen upon the steep-cut sides, like talus at the footing of a weathered cliff. At different levels, down the sides, were giant ledges of lime and salt as if, at each of these succeeding levels, the water had stood for many years, creating shore-line after shore-line, each lower than the last; until at last the life-giving moisture went up into the dry air, and left old Tellus arid."

"Yes—" broke in Salvarius with impatience—"but the cylinder, and the traces of the dying race——?"

The younger man was firm in his desire to tell his story in his own way. "These details are important," he asserted, "if you are to understand the last wretched struggle of this people at the bottom of what had once been this world's deepest sea. For it was at that deep-cleft valley, I am sure, that the final drama was enacted."

"Go on:" this from Salvarius.

"I came, at length, examining ledge after ledge, down the steepest side to the bottom of the valley, which is broad and level, and of a length, I should say, about one three-hundred-sixtieth of the polar diameter of the planet. Its axis lay, roughly, at an angle midway between the line of the equator and a line drawn directly from pole to pole. The deposit of earth in the bottom was deep and thoroughly intermingled with crystallized salt; but here and there outcrops of rock jutted through. The lowest portion of this bottom was near the center of the valley; and toward this basin, indicated broadly to the eye by the contour of the layers of deposited salt, I carefully made my flight.

"I had not gone far before I began to perceive that what I had formerly thought to be natural rocky projections, reaching upward through the soil, were really the outlines of a once-formidable city of stone. The work of the hand of man, upon the uppermost sides of the blocks which met my eye, was unmistakable. Pausing, I cast my eye back over the valley floor whence I had come. I then saw that, at some time in the distant past, this whole area had been covered with stone buildings arranged in geometrical rows, with streets between, and squares, courts, avenues and open ways.

"Like some avenging power, the shifting soil, which once had formed at the bottom of an endless sea, had drifted with the brief eddying winds, which still linger here, into the outer fringes of that city. With the passage of time, new deposits had been blown into the gulf, to further obliterate the work of men. I know not whether there were men still living there when the dunes first came. I could not tell whether the last weak members of the race, caught between the drouth on one hand and the encroaching dust storms on the other, had lived to see their last stronghold on the earth buried before their eyes; or whether, mercifully, they were all dead and gone before the burial began.

"In any case, perceiving that the hummocks of stone over which I had been flying were not natural pillars of living rock, but rather the tops and spires of an extinct city, I hovered carefully among them; always directing my progress toward the lowest part of the vale, where the last remnant of all the water of Tellus had once lain. As I proceeded, I reached an area where the drifting dust has not yet completed its work; the upper parts of buildings project here above the surface. Cemented by hands now dead, great slabs of stone lie roof-like upon pillars cut and curiously carved.

"Still I proceeded on. Now, as I moved, I found myself above what had once been a street, though covered probably by a hundred feet of earth. On either side the buildings rise; some tall and stately, reminiscent of wealth and refinement; others less attractive, but fascinating still for the story they could tell. Here and there a tall-spired building thrusts its finger of stone high into the air above the sand. These places I took to be temples for ceremonials of some kind.

The Cylinder

"ABRUPTLY, as I glided, the city seemed to fall away, and end on the shore-line of what was once a vast and ancient lake. There still may be seen the crusted ledge which indicates the former water level at the bases of these stately buildings. Beyond it, the basin dips to deeper levels, and here also are the successive water-lines, which marked the agonies of a despairing city. Strewn far and near amid the cruel salt, I perceived what might once have been bones; but whether of man or beast I could not say. Were they the wretches who had lived to see the final remnant of water vanishing—what scenes had been enacted in this basin?

"It was at this point, when I was about to turn back to search among the ruins for some tangible evidence of human life to bring to you, that I beheld far off, rising above the very lowest spot of all the vast salt basin where I hovered, a mighty tower of stone, rounded and firm, projecting upwards some

hundreds of feet. How it had come that I had previously overlooked it I cannot tell, unless it was from the blinding glare of sun on salt.

"I cannot tell you with what mingled feelings of dread, hope and curiosity I beheld this last upright relic of a vanished race. As if by instinct I knew it for what it is—a mighty tombstone erected by the last survivors of the men on earth to commemorate all who had died, and to remain throughout the ages as proof that the race had lived.

"Perceiving that the drift would ultimately fill their wide streets with its glittering substance, and in time the mighty city itself would be buried beneath the desert, these people must have selected the spot where their last remnant of water was collected, to erect this mighty monument. They made it high enough to escape indefinitely the encroachment of the sand; firm enough to last eternities, and beautiful enough to attest to the art and science of a forgotten race.

"Straight up it rises like some huge crystal of milky quartz, fashioned of a substance I have never seen before; seamless and bright and of such proportions as to take the breath away. Its base had been planted in the earth to an unknown depth. It is as broad and wide where it emerges from the surface as the highest building in Nealoma, our foremost city on Pleida. In rising upward it slopes inward on every side to form curving terraces, so contrived as to excite the mind and cause the eye to sweep on upward to the heights.

"I passed around it just above the ground, and found no door or opening of any kind. The glassy surface reflected the sun as sharply as the innumerable glittering crystals of salt which lay on every side. I perceived that it is, indeed, at the lowest spot in the whole valley, the spot where the last remnant of earth's last lake had been. The sand has not yet drifted there; in fact the earth, it seemed to me, has hardly dried. We did not come very much too late, O Salvarius Carde, to find some moisture on the earth. Perhaps five earthly years ago, perhaps but one or two, there was a little pool of salty water standing there. It is clear that the tower was built *before the water was all gone.* There are no tracks about the base of the tower; there are no signs of skeletons for hundreds of yards. It seemed as if the Tellurian people, perceiving that their end was near and inevitable, had built up their cenotaph, buried their dead, and themselves committed suicide rather than undergo the tortures of death by thirst and hunger."

"But the cylinder—" interposed Salvarius Carde, put out by so much explanation and detail.

"Ah, yes, the cylinder," Marce replied: "I will come to that at once."

He cleared his throat, speaking louder so that other members of the expedition might hear him.

"As I moved around the tower and found no door, it occurred to me that these Tellurian engineers had refrained from leaving an opening near the base of their shaft for the obvious reason that the drift would soon reach it and close it up. For the same reason, they had left no writings near the base. One should look for these things nearer the top, perhaps upon the top itself.

"Deciding that this reasoning was accurate, I rose higher into the air, and circled the tall shaft upward, moving around and around, my eyes upon the polished surfaces gleaming in the sun. There are no marks, no inscriptions, no doors or windows, no signs of any kind on any side. Upward I swept, until at length I beheld that the top is not flat, but slopes broadly like the ends of certain crystals. Here there is neither a door, nor inscription; but before my startled eyes there stood a single figure, carved of the same glittering stuff as the tower itself, and shaped, I take it, like the members of the race which had left it there.

Back to Pleida!

"THERE is this difference, however, between the material of the figure and that of the tower: Whereas the substance which formed the building is almost white, milky-clear, and highly polished, this startling figure standing silently at the top was *black.* It was the statue, I presume, of a Tellurian man; perhaps a priest or scientist. There was no beard; the garments were loose and flowing and fell below the knees. An object rested upon the head, perhaps a badge of distinction, and the left hand clasped a rod, the end of which rested on the pedestal. It seemed obviously a staff of authority or a symbol of some custom.

"But what interested me most was that in the right hand, out-thrust in the gesture of bestowing a gift, was this cylinder. Upon the face of the figure there seemed to be a sad and weary smile, as if upon the completion of the mission in which he was engaged, he, too, would die and disappear. The figure appeared to be fast and firm at the base, as though melted into the substance upon which it stood.

"Since the outstretched hand clearly invited the beholder to take the cylinder, I alighted, and sought to do so; but at first I could see no way to loosen the stony grasp and wrench it free.

"It seemed uncouth and ghoulish to grapple with that stone replica of a dead race, even upon invitation to wrest from its grasp the object it had held so long. But, at last, I beheld that the thumb of the outstretched hand, which closed over the top of the cylinder, was so contrived that with a little lateral pressure it could be moved aside. Quickly I did this, and was then able to pull the cylinder away. The thumb moved back into place, as if actuated by a hidden spring. *And, though I may be thought insane when I declare it, I heard the image sigh, as in relief.*

"Then, while I poised there, amazed, inarticulate with surprise and horror, the surface beneath the statue automatically moved, turning half around to the accompaniment of a humming sound. The figure slowly dropped its arm. Its face, turned to-

ward me still, bent on me that sad, inscrutable smile; and, quick as a plummet, the whole figure dropped through an opening and disappeared. I tried to leap forward and catch it; but the automatic mechanism which had undoubtedly removed the thing was too quick for me. There was a loud snap; and a trapdoor had closed the opening so tightly that no efforts of mine could budge it.

"Atop the crystal tower, now bare, I stood with the ancient cylinder in my trembling hands.

"I spread my wings and brought it here to you, as swiftly as I could pass through the Tellurian air."

Allus Marce bowed his head while Salvarius Carde stared at him. The leader regarded the cylinder with new interest, as though speculating on the truth of the younger man's story.

"It is enough," he said: "Allus Marce, you shall be rewarded for bringing this—provided it contains the evidence we are looking for."

Mechanics were summoned; in the presence of all the members of the expedition, they twisted open the metal case. Inside were many sheets, closely-written, in a script none among them could interpret.

"I should like to stay and investigate farther," said Salvarius at length, "but already we have overstayed our time. Our supplies have run short, and the only useful element this planet can give us is oxygen. We will take for granted that this message can be deciphered on Pleida by our scholars, and that it will tell us all we care to know."

He called the explorers in, the mechanics and engineers, the space-navigators and the rocket-experts. With their help, he refilled his tanks with oxygen for the return journey. Some of the men took stones from Tellus to commemorate their exploit; others preferred to have about them no object to remind them of the dreary days on this scarred and lifeless planet.

The mighty doors of the space-flier were closed and made fast. The rockets suddenly roared, and the ship flew upward like a brilliant bird a-wing, straight toward the sun; then turning, it moved off in the direction of Pleida.

CHAPTER II.

The Wailing Cry

THE burning disc of the sun had passed once more over the parched plains of the dying world; it was near its setting beyond the deep valley which Allus Marce had visited. The last harsh rays played brightly upon the fields of salt; turning them to gold and crimson upon the heights until the valley seemed filled with blood. The sun's beams, passing through the millions of miles of cold outer space as with a purpose foreordained, reached across the farthest heights of the valley's edge and touched with a delicate yellow finger the upper part of the milky shaft. Thus outlined, it stood like a sentinel guarding the basin, below the ruined city and its dead.

Everywhere lay the encroaching drifts, the gleaming salt. The tower itself, a finger of almost luminous beauty, betokening the spirit and strength of a race now vanished, seemed alone among the works of man to have survived. It alone had defeated the forces of destruction which were concentrating their efforts here to wipe out the last of human handiwork. Of the buildings of the ruined city, only a few at the very fringe of the lowest basin were still standing; and already they were leaning crazily this way and that, groaning with the weight of years.

Even as the sun settled westward at the valley's amber rim, one of the few remaining edifices of brick and stone gave up its brave struggle against the drift. With a rumbling sound which travelled up the barren valley and echoed back, it fell outward into the dry bed of the ancient lake. Clouds of white dust, released from the mortar and stone, rolled upward in the still evening air.

Was it an illusion that at that moment, as eternal silence settled once again upon the valley, a thin, wailing cry arose from the ruins of the demolished building?

Following hard upon the mighty rumble which had marked the building's end, the valley was suddenly tremulous with a cry, half human, half animal, at first rising in pain and despair, then quieting to resignation. Then it ended in a strangling sound. If it were a man who uttered such a sound, then his cry was that of all the race which had gone down to death, suffering from the consequences of its own sins. It was the cry as well of plants and animals, of worms and slimy things, of bird and beast and reptile from the beginning of living time; it was the universal wail of despair and then of resignation in the face of death.

The thin echoes rolled against the precipitous valley walls, and echoed back again. Then came silence. Not even the common rustles of the night, birds or insects, marauding beasts, or fluttering bats were there to voice their presence in the fast-approaching night. The end of the world and the universe, would not find old Tellus more deathly still than it was then.

The smothering dust settled slowly back. The cries from beneath the debris had ceased. No eye upon the surface of all that hollow could have discerned the slightest sign or hint of life. It seemed, indeed, that the world was dead.

Nevertheless, there was life on Tellus still. The milky tower, now glistening in the twilight like a fountain of silver, ran like a hollow needle far into the earth beneath. There, at its lower end, a passageway led northward. Beneath the valley's boundary cliffs it passed, and onward toward the north beneath dry mountains of ledged and furrowed rock.

For a distance greater than half a mile it passed that way. Then, with a quick turn, it rounded a glittering adamantine substance in its path, and opened suddenly upon a subterranean chamber so

vast, so hollow and alive with echoes, so bright with phosphorescence and the sparkle of light from many-faceted jewels, that the first man who beheld it must have stood amazed.

Waiting

IT was one of those underground hollows long known to exist beneath the earth, hollows lighted by a natural radiance and supporting forms of life of its own. This one, like many another of lesser extent, had in its center a cool, silent lake of the purest water. Within the deeps moved fish of strange kind, such as had never been seen on the surface. Upon the murky shores there were many varieties of pulpy plants, evil and unhealthy to look upon, but nevertheless alive.

The gloomy lake was perhaps a mile long, and somewhat more than half as broad. The sloping beaches moved away fanwise on every side, until they touched the serried cliffs which formed the cavern's walls. The roof was domed and fantastically carved; as though the hand of a playful giant, having at his command every gem and metal, had amused himself with tracing patterns and arrangements intricate beyond human comprehension. Perhaps, pleased with his handiwork, he had placed behind it a chemical luminescence which brought out the details like a cameo; a jewel framed in the everlasting rock!

Along the left bank, skirting the silent edges of the pool, a footpath ran from the mouth of the passageway to a point almost at the opposite end of the cavern. Here a series of low, dark spots betrayed the openings of cavern-chains beyond. In the centermost of these openings glowed a faint yellow flickering light of fragile warmth. Against its glow, from time to time, there appeared, in the opening, the shadowy form of a human being, clad in loose-fitting robes. As it passed the portal it often paused, as if to survey the lake, the beach and the strange vegetation. It was, plainly, watching for the approach of someone from the direction of the passageway which led toward the milky tower and the city's ruins.

But no such person approached. There was nothing to be seen but the quiet pool, the never-moving fronds of the vegetation, and the flicker of the light above as it played upon the jeweled dome.

The interior of the great chamber, for all its brightness and display, was intensely quiet, more silent if possible than the dead world outside. The slimy creatures of the water's depths never broke splashingly to the surface but crept along the bottom, burrowing in the mud. Among the patches where vegetation grew, there were other living creatures; but they, too, moved silently here and there, as though the oppression of the centuries were upon them—as if they dared not break the silence which had lain upon that air so long.

Thus it was that the sound of human voices came drifting at frequent intervals across the pool. There was a heavy voice, and another that answered it in lighter tones.

"He isn't coming yet?" the deep voice inquired.

"He's not in sight."

"Then something has happened. Something unusual has kept him out. He's never been so late before."

"But what *could* happen?" the softer voice replied in alarm: "It has been centuries since there were animals. We have no enemies—" the voice laughed bitterly:—"He has only stopped outside longer than there was need, perhaps to watch the sky. It's bright and cool these nights; there are no clouds—"

Then, later, the deep voice said:

"I wish you'd go and see."

The shadowy figure came to the portal once more, and stood there, staring out into the greater cavern for some time. At length it turned back again.

"I'm worried," confessed the heavier voice again: "There's bitter irony in that, too. Imagine, trying to maintain the last spark of human life on a dead planet. Imagine, when we are all doomed to death and extinction with the passing of your life, his and my own, that we should struggle for the prolongation, even by a day, of our wretched existences!"

The same figure reappeared in the entrance suddenly. With some remark which was swallowed up in the depths of the cave behind, it advanced rapidly along the path toward the outer passageway. The figure was slight and quick; yet in the manner of walking it betrayed a certain resilient strength and endurance.

As it drew near the entrance to the passage, the light fell upon it more fully from above; and it was plain that the slender figure was that of a young woman—hardly more than a girl—with a body so beautifully formed that its lines showed their splendor, despite the concealment of the flowing wrap about her. Her face was finely cut, the features regular and strong, the eyes bright and intelligent. Her mouth was sensitive and delicate; but it also showed determination of purpose and fortitude; qualities which were needed, surely, for an existence such as this!

But there was about her something more striking than any of these things. As though carefully tinted by a most exquisite artistry, her skin was a deep, ebony black, supple and firm.

In her right hand she carried a flaming torch, though it was scarcely needed in the brightness of the cavern. The smoke from it whirled up overhead as she walked. The flame, moving first to one side and then to the other, by turns illuminated her face and obscured it. The torch, the trail of smoke, and the shrouded ebon figure moving quickly along the narrow, well-worn pathway beside the motionless lake were like the figments of a haunted dream.

She walked quickly, with a firm, even tread; unafraid, yet with evident distaste for the gloom and strangeness about her. When she reached the opalescent boulder, around the left side of which the passage ran outward toward the tower, she paused

for a moment, while the flame above her head blazed high.

"Nino! Nino!" she called.

The echoes answered her, howling like demons from the vaulted roof, the dripping walls, the bosom of the deep lake. There was no other sound.

Pausing for another moment as if undecided, she finally turned her back upon the opening at the left of the obstruction and passed partly around it. She entered a smaller passage at the right, which ran outward, beneath the valley, in a somewhat different direction. She was now walking toward the city which the drifting dunes had stolen from its builders.

The yellow reflection from the torch followed her for a moment down the passageway, and was gone.

CHAPTER III

His Kingdom

THE light of the open fire flickered uncertainly, in the rocky inner cave, sending its yellow rays against the rough-hewn walls where strange spiders spun their gossamer webs and stared down with beady eyes. Kettles were aboil upon a makeshift crane. In a small recess, before a hand-made desk, sat alone an aged man, his flowing white beard reaching past the table-top, obscuring the fastenings of the cloak which fell across his shoulders and was gathered upon his chest. His gaunt hands played with a queer metallic pen; and on a sheet of white paper before him there were a few lines of scrawling script. The uncertain light of the fire had been augmented, in the niche, by a candle, down whose sides the wax had run until the desk-top and the nearest leg were smeared and streaked with it.

"Who should have thought that Man would live to see his proud race reduced to this state?" the old man had written: "Emerging from the primordial slime at the beginning, we took refuge in caves, and from them moved outward to work our destiny. Now, sinking down again into that eternal night from which there is no return, having again fled to Mother Earth's great caves—"

The end of the sentence trailed off into an illegible scrawl. As if there was much more to be written, but little enthusiasm for the writing of it, the author of the paragraph was toying with his pen; now putting the thick end of it to his lips contemplatively, now drumming with it upon the wooden top of the desk, now permitting it to lie idle in his fingers as he gazed, somewhat anxiously, toward the open mouth of the cave.

At length, throwing the pen down upon the desk in disgust, he arose with great effort, and, taking a short walking stick from its place against the rough wall, began to make his way with difficulty toward the entrance and the pool. As he rose to his full height, it was plain that in his youth and middle age he had been a majestic figure. Tall, well-proportioned even in age, his sharply-chiselled face bespoke intelligence and the habit of authority. His skin, like that of the woman, was black, contrasting with the luxuriant full white beard. His clothing, like hers, was loose and flowing; such garments, typical of hot countries, permitting the maximum of air circulation beneath, and great freedom of movement. He carried with him a learned and august dignity which seemed to be token a broad benevolence of spirit; but at the same time there was singular sadness and hopelessness in those eyes, which had already looked too long upon the death-throes of his race.

From the table to the opening was but a short distance, but the old man took a long time to get so far. It was plain that the infirmities of age were heavy upon him; the legs which had borne him faithfully through a long life would not carry him much longer. Beside the entrance there was a stool, so placed as to permit the occupant a broad view of the entire cavern. Reaching this he sank wearily upon it, keeping his staff in hand, and for half an hour he stared gloomily toward the other end of the lake.

"Now I am monarch of all the earth," he mumbled to himself, ironically: "This is my kingdom!"

Time passed slowly. Still the woman did not return. Oppressed by the silence and the waiting, the old man again rose and made his way back into the cave, toward the fire, dragging the stool with him. He set it down before the blaze, and rested again, his feet and hands spread out to catch the warmth.

He looked around him in the cave, which the fire had lighted up. There was near at hand a stock of fuel, the dried stalks and roots of the cavern's chief vegetable growth. It burned eagerly, with much snapping and crackling, exuding an inflammable oil which helped to sustain the blaze. Also, there was a stock of food, from the deep's lake's yield of unnamed fish, and a quantity of the root of an edible plant. Unpleasant to eat and use, these things nevertheless would sustain man's life for a long time to come. It would be possible, perhaps, to rear whole families here, to build a new race.

The old man seemed lost in thought, revolving in his mind a weighty problem which had troubled him often before. At length he hobbled back to the littered desk. With determination, he took the pen between his fingers, and dipping it into a horn of ink, began to write.

"If there shall ever be another living being," he wrote, "to read these lines, besides my son and daughter, who with me are the sole survivors of the earth's millions, let them place the blame, if there be any, upon my head for what I am about to do. My days upon this wretched earth are numbered. I foresee the end; and shall be content if only I am permitted to watch the sun go down once more in the free open air. But as to my son and daughter, alas, in them resides the destiny of this cursed remnant of the race.

"Living in a cave like beasts, we reach back after many generations to the moral values of the beast! For, though I have fought the idea with all the force in my being, trying to summon up all those reserves of moral fortitude, repugnance and horror which have existed in our people since the dawn of time, the monstrous thing I am about to command does not seem monstrous to me, now, but necessary. Necessary! The last struggle of a dying race, which even at the end cries out for life, is making me the instrument of its desire.

"My son and daughter are the only human beings upon this earth capable of continuing the race.

"Continuing it whither? I know not. The end, it seems, must be inevitable. This generation or the next—it makes little difference in the end. Still, I cannot bear the thought of its perishing utterly so soon, while there is yet power in my command, and in their bodies, to carry it on.

"Perhaps, who knows, our messages beseeching aid from other planets may yet be answered—even after so long a time of waiting.

"God of the Universe, if indeed there be such a One—I ask forgiveness—"

All Hope Gone

THE pen dropped from his trembling hands and rolled to the stony floor. He did not reach for it, but stared straight before him at the hard wall. "Strength, strength," he muttered: "I must be firm!"

He heard hurried footsteps along the path outside. Someone was walking there, coming toward the cave.

With a quick motion he blotted the fresh ink on the paper before him, and covered what he had written with a clean white sheet. Then he composed himself with an effort, and turned half around to face the entrance, with a weary smile, partly mechnical, upon his lips.

He did not notice, when the girl appeared at the portal and turned to walk inside, that her hair was disheveled, her clothing soiled and torn, her torch gone. He did not see the horror in her eyes or the signs of weeping. He observed only that she was out of breath, as if she had run a great distance.

"You have been gone—a long time, Nina," he said kindly: "I was a little worried for a time. No doubt you found everything all right with Nino. When is he coming in?"

The girl hesitated a moment before answering, as if choosing her words.

"Father," she said at length, quietly, "Nino——is dead!"

"Dead?"

Despite his age and weakness, the old man rose up to his full height from the stool, and raised his trembling arms above his head in a gesture of the utmost grief and despair. His face was suddenly drawn and seamed; his eyes betrayed the shock the news had given him. He sank back upon his seat again. It was some minutes before he could speak.

The girl stood silently by the fire, looking into it stoically, as if life had taught her to take all things calmly.

"When I went out to look for him," she said after a time, "I hurried down the passageway toward Mansende and the old building where Nino used to take up his watch of the valley and the beacon tower, waiting for an answer to our radio signals to the other planets. The passageway, you remember, runs at an even level underground to a point below the building; then it goes upward by a long flight of stairs.

"I had no difficulty getting nearly to the end of the passage. But there, almost within sight of the lowermost flight of stairs, I was assailed by a frightful cloud of fine white dust. Fearing that something terrible had happened, I ran on through the choking stuff, guarding my breathing as well as I could, and began to make my way up the dark flights, now covered on the lower portions with debris. I saw that the shaftway no longer showed the spot of light which used to mark the upper opening.

"The piles of debris grew thicker as I climbed. I found one place where the stairs had given way. A little farther up, a great stone blocked my path. I laid my torch down and struggled with it, finally succeeding in moving it enough to let me through.

"Then I perceived what had happened. The old building, giving away to age and the pressure of earth, at last had fallen in. Crawling through cracks and dark holes, I finally reached the top of the stairs, and there I found—Nino! He was dead, crushed horribly beneath two huge blocks which had formed part of the arch of the roof. Apparently he had heard the building begin to fall, and had sought to make the passage when it was too late."

She paused. The old man wrung his hands.

"My God," he moaned: "Why should it have been Nino? Why not my body, worthless as it is, instead of his?"

The girl, evidently misunderstanding, hurried to his side and stroked his hair and face, comforting him.

"We must not lose our courage now," she reminded him softly: "We two—alone—must face it out!"

"Yes—yes," he murmured: "Perhaps it was intended so—"

Then with a sudden motion he reached his hand out to the desk. His fingers closed upon the papers there, and with a convulsive grasp he crumpled them. The girl had not noticed, or she had pretended not to see, what he had written.

"Nino did not die without leaving a message," she said after a pause: "He had some paper with him and a pencil. While he lay dying upon the

stone floor he wrote a note to us. This slip was in his hand when I found him."

She reached into her tunic and brought out a crumpled page. Upon it, scrawled by one evidently in haste and in intense pain, was this message:

"You can't get out this way or any other unless help comes from the outside. But do not give up. Today I saw a great white bird alight upon the beacon tower, move the thumb and take the message, with which he flew away. I think—"

The remainder of the sentence was obliterated by a dark red stain. Holding it to the light, they saw that it had never been completed.

"Was the passage blocked, as he said?" asked the old man.

The girl nodded.

"I could not get farther than his body. There is no chance to force our way through that pile of stones," she replied.

"Then we are trapped. We can't get out."

"But perhaps—the white bird—"

The man shook his head.

"That's nonsense," he said. "Delirium."

"Nino was hardly the kind to lose his head, even if he was suffering."

"I know; but Nina, there are no birds on the earth any longer. Our people shot many of them for food; the others died of thirst. Poor Nino—poor Nino!"

Doomed

THE old man's grief was seriously affecting him. He put his head upon the stained and greasy desk, burying it in his arms, while the waxen candle flared and flickered nearby, its melted substance running in long ridges down its side.

"But, whether it was a bird or not," the girl exclaimed, "something took the cylinder and sprang the trap."

Her father raised his head and stared at her blankly. "Nina," he asked, "Is it true? The trap was sprung?"

She nodded: "When I left Nino I went down the other passage to the tower. The image had been sent down the shaft, by its weight's drawing up the ladder, as we had arranged. The trapdoor at the top is closed, but it can be opened by anyone capable of reasoning out how to free the cylinder. Perhaps the stranger did not stop to read, or needed a translator."

"The message was taken!"

The old man for the moment forgot his sorrow in the new excitement: "You're sure the cylinder is gone? The jointed thumb had been moved?"

His daughter nodded: "I looked at it carefully," she said.

"Then it was an intelligent creature who found it! Was there any sign of livings about?"

"I climbed up the stairways and the ladder to the top, and opened the trapdoor so that I could examine the whole valley, and even the edges of the surrounding cliffs. But I could see nothing. There are not even tracks!"

"That's strange—"

"Unless our visitor was extremely light, or unless he only flew, and never alighted. Nino wrote of a white bird."

The old man smoothed out his manuscript thoughtfully and returned it to the desk.

"In any case," he said, "we have not yet been rescued, though hours must have passed since they found it."

He took his daughter's hand. "Now there are only two of us," he murmured, "and soon there will be—only you, Nina."

She shrank in horror from the gloom and silence of the cavern, but she did not reply. Instead, she put her strong young arm about his shoulders, and held his head close to her.

"Oh, help will come," she declared after a time: "I'm sure of it."

Aiding him tenderly, she guided the old man across the uneven floor to his stool before the fire. Then, throwing upon the blaze a fresh bundle of fuel, she nestled down beside him to watch the flames leap high; to take solace with him in the friendly warmth which had cheered the members of the human race from the dawn of mankind.

In the dark crannies of the cave, strange insects watched these doomed members of a once proud race, their figures silhouetted against the yellow miracle which they had brought with them into the cavern.

Outside, in the valley, a little wind had sprung up; and the sweeping dust came cascading over the high walls of the hollow, to continue covering up the tomb of Man and to erase from the earth the last marks he had made upon it.

CHAPTER IV

Dolmician, the Emperor

THERE was a long procession winding through the silvery streets of Nealoma, accompanied by the deep booming sound of *Anathryptic* drums, the sweet, sharp tones of the *nantigore* played with a muted bell, and the ripple of many feet moving rhythmically on the hard surfaces; and there was, too, the rustle of broad wings. Bravely-uniformed guards, beribboned like pages in an Ardathian court, passed and repassed over head. On either side of the line of march—their wings folded but ready, and in their hands the short *sythus* which had done such mighty work in the campaigns against the Helvae—stood the proud legionaries of Pleida, keeping back the crowds who pressed too close in seeking a glimpse of the daring travelers.

The air was close and singularly hot, despite the distance of the sun; the ground was warm. Heat seemed to come outward from the core of this world, turning the moisture of the soil to vapor as it came, and filling the atmosphere with quivering waves. Great as was their distance from the sun,

the streets were filled with a brilliant light, of peculiar blue-green intensity, greatly unlike that which played upon the face of Tellus. It was the quality and nature of the Pleidan atmosphere which changed the sunlight, straining out many of the red rays, and emphasizing the blues and greens. In addition, there penetrated to the surface much more of the actinic rays than reached the surface of the dead planet; and the bleaching effect of these rays was everywhere apparent.

It was not noticed, however, by the race of short, squat phlegmatic people who inhabited the major portion of the planet. Even the great weight of every common thing, more than two and half times as great as it would have been on Tellus, did not seem to trouble these beings. With the aid of gravity nullifiers, they flitted to and fro, either in the air or on the ground, with little apparent effort; where a Tellurian man would have been made helpless by his own weight.

The procession moved through a carnival of little multi-colored balloons and bright paper discs between the ranks of cheering gaily-clad citizens who lined the route on either side. The chief streets of the city shone with pageantry. Crowds upon the high rooftops shouted welcoming cries through megaphones. Bands played and accented the rhythms of the march. But an observer might have perceived that such emotion as the people showed was simulated; that, between their exclamations, their faces relaxed into that stony gloomy mold for which Pleidans are noted.

Ahead marched the *Bala*, lifting their arms rhythymically above their heads, and indicating that an event of importance to the whole universe were about to occur. The special guards came next, marching three deep before and after the jeweled guests of honor, who moved in double file, looking neither to the left nor right; for it was improper to acknowledge the plaudits of the crowd until respect had been paid to the Emperor.

Straight ahead, before the marching lines, stretched the great avenue; and at its end, upreared against the green-gold sky, stood the broad, blocky palace of Dolmician. The terraced steps ran upward to portals guarded on either side by tawny *selins* in precious metal, the symbol at once of authority and cruelty. Beyond the portal opened the hallway, nearly as wide as the street, and at the far end of it was the auditorium where sat the mighty Dolmician himself. Enrobed with garments signifying his power and degree, he awaited in the Emperor's box, the marchers. His receiving ring gleamed upon his fat third finger, the jewel out; and a smile of welcome was enforced upon his countenance. His short, squat figure seemed more a block of carved stone than a living man.

At the terraced steps the guards marched ahead; the line parted into two columns between which passed the honored men. Salvarius Carde was first to enter the presence of the Emperor. In his hand he carried the metal Tellurian cylinder, now beriboned and much polished in an attempt to make its appearance more acceptable. After him came the others of the expedition, with Allus Marce, the youngest, bringing up the rear. On the bodies of all were the dull metallic boxes holding the gravity-nullifying equipment. They knelt in deference.

"Arise, Men of Pleida!" boomed Dolmician: "You who have trodden star-dust need kneel no more before an Emperor!"

At that the courtiers and nobles, of whom there were myriads lining the audience chamber, set up a great roaring noise. Heavy throbbing music from unseen sources poured out into the great hall and, as though the blessing of the Emperor had indeed been translated into sight and scent, there came dropping from the arched and darkened vault overhead, the brilliant, tinted petals of the night-blooming *antinone*, accompanied by clouds of perfume.

Salvarius Carde, all smiles at this triumph, stepped forward, the cylinder from Tellus in his hand.

"Behold the last message of the Tellurians," he declared: "We have preserved it for your Serene Majesty that it may be translated at your command. As for the Tellurian race of which tradition speaks—it has disappeared."

"What? Disappeared?"

"There were no traces of anything alive; though we searched diligently over the whole planet, and especially in the deep, dried-up basin where this cylinder was found."

"Ah," replied the Emperor, apparently but little disappointed: "Trust Salvarius Carde to do everything that was necessary! Had these earth-men had such a leader among them, they never would have perished; he would have found a way."

Carde's Story

SALVARIUS bowed low at this declaration of his ruler's esteem. "Perhaps so, Sire," he replied: "But I really feel, O mighty Dolmician, that you praise me more than I deserve."

"Not at all. On the contrary, we feel that your obvious talents will stand us in very good stead in certain enterprises we are even now contemplating."

"I thank you, Sire. But, experienced though I am, neither I nor any member of my family, so far as I know, has ever succeeded in creating water where the elements necessary to its existence were absent."

"Water?"

"Yes, Sire. It was from lack of it that the Tellurians perished from their earth."

It was apparent that the Emperor was no longer interested in the Tellurians.

"Well, well," he declared, pursing his lips sorrowfully: "What a pity!"

"But may I tell your Serene Majesty of the circumstances connected with the finding of this cylinder, which I believe contains a history of that unfortunate race?" persisted Salvarius Carde.

"Yes, yes—of course."

Allus Marce flushed with excitement, remembering that it was he and none other who had discovered the relic. Now would the Emperor learn that there were other good men besides Salvarius Carde!

It was difficult for him to keep his place. With the eagerness and inexperience of youth, he wanted to move forward and stand beside Salvarius Carde during the recital of the tale; perhaps to tell it himself, as was his right. None but he had seen the valley which had been once the bottom of the sea. He alone had mounted the crystal tower, wrested the message from the graven figure, and watched it descend, plummet-like, mocking him with its inscrutable smile.

He aroused himself from these reflections to perceive that Salvarius Carde had already launched upon the story. Suddenly Allus Marce's ears burned; his face grew red with anger and indignation. For, as he listened, it was apparent that Salvarius Carde, without even mentioning the true discoverer's name, was telling the tale as though he himself had found the lost valley and the treasure it contained.

"Adjusting my portable gravity-nullifier on my back—for, as your Majesty knows, the force of gravity on Tellus is considerably less than on Pleida, I flew across the planet. I came at length," Salvarius Carde continued, "to a valley deeper than any other in the pitted surface of Tellus. There, in its bottom, partly covered by sand, is the ruins of a great stone city. And upreared in the center of the city, its base already covered over with the sand so that a door no longer shows, is a giant obelisk. Upon the top of the obelisk was a carved figure, purporting to be that of a Tellurian man. In the figure's stony hand was this cylinder, plainly intended as a message to anyone visiting Tellus and wishing to learn the history of the race which had perished there.

"As you may be certain, Sire, I approached the figure firmly and wrenched the cylinder from its grasp. I would have brought the figure also with me to Pleida, in order that it might be mounted in one of our mighty museums here; but an unfortunate accident prevented that. The mortar which cemented it to the obelisk's top was aged and crumbling. I should guess that it had stood there, exposed to the fury of the elements, for hundreds of years. As I took the cylinder, the mortar at last gave way, and, before I could catch it, the statue had tumbled over the side and dashed itself to pieces against the ground.

"Your Majesty will understand that I regretted this loss exceedingly; so much so, in fact, that I sat down beside the pieces on the hard ground and gave myself up to grief for half an hour. At the end of that time, perceiving that the loss was irretrievable, I left the fragments where they had fallen and hastened to the space-ship. There the other members of the expedition, having spent many fruitless days in searching for relics, gathered around me. We wrenched the cylinder open and learned that there were indeed writings inside; though of such strange characters that we could not understand anything of their nature."

Allus Marce gasped in astonishment at the effrontery of this narrative; and would have burst out in denial, had not one of the other members of the expedition, perceiving the young man's perturbation, placed a hand on his shoulder and whispered softly into his ear.

"You must not——now!" the other remarked: "To disturb the equanimity of the Emperor at this time would cast no discredit on Salvarius Carde's story, and would only do your own reputation and future irreparable harm. There are others who know the truth besides yourself. Wait until the proper time comes before you declare yourself."

Allus Marce breathed fast, but kept his peace. He nodded to his companion, who smiled momentarily. Then both of them turned their eyes steadfastly toward the Emperor, who was regarding the ribboned cylinder, poising it in his pudgy hands.

"Call in the official translators!" he ordered imperiously.

There was a hubbub among the servants of the court. In a moment the seven translators were brought, each dressed in a robe which signified the degrees he held and the exploits which had endeared him to the Emperor.

"Inside this metal container," said Dolmician when they were all assembled, "I am reliably informed that there are sheets bearing a message from the extinct races of the planet Tellus. I want that message translated, as soon as possible, and the report of its contents made directly to me."

Honors Bestowed

THE eldest of the translators, finding the cap already loosened by the efforts of Salvarius Carde's mechanics, unscrewed it with his hand and brought the message out. The six others gathered quickly and somewhat anxiously around him, scrutinizing the sheets. Then they held a short conference, and at length the eldest spoke.

"All-powerful Emperor," he began in his humblest manner, "we here see that a task of no mean proportions has been set for us. For we have neither key nor experience with this language or these characters. It will take time to translate such a message as this."

"How much time?" inquired the Emperor impatiently.

"No man could with certainty tell you that. It may take years; it may take lifetimes."

The Emperor frowned.

"Too long! Too long!" he thundered! "I will have no such delay. A day or two at most should do the work. See, there are fewer than two dozen sheets. Lifetimes, indeed!"

He waved the uncomfortable translators toward the gallery door. "Don't waste my time," he bel-

lowed after them: "Bring me a translation before two days are gone, or I'll put the work in better hands!"

Smiling, he then turned toward Salvarius Carde, who was standing expectantly at the head of the band of explorers. The Emperor clapped his jewelled hands.

"Salvarius Carde," he exclaimed in the high, sing-song voice appointed for ceremonials, "I do now appoint you a noble among nobles, with the title 'Guardian of the Universe'!" He clapped his hands: "The robes!"

Four squat blocks of humanity, called pages, bearing the garments of power and the symbols of the new estate, appeared from the sides of the great hall and bestowed upon the pleased and preening Salvarius the symbols of his rank, while the auditorium rang with the monotonous, lifeless applause.

"And as for the other members of your expedition," continued the Emperor, ponderously, "them do I entitle Honorable; recognizing that, though they brought no relics of the people of Tellus, they nevertheless have been of some assistance to you in the work which you have accomplished so well. As a reward for accompanying you, I will cause their names to be inscribed on a table of imperishable metal, and the tablet to be placed in plain view in the main hall of my palace; so that future generations may come and look upon it."

"How generous is the Emperor!" cried the hundreds of nobles present, perceiving that there was universal disappointment in the faces of the followers of Salvarius Carde. So loudly did they cry it that the Emperor himself smiled in their direction, acknowledging their praise. With that the music struck up again, and the great Dolmician arose and turned the jewel of his ring inward toward the palm; signifying thus that the ceremony was over.

The nobles were hurrying from their places to greet the proud and beaming Salvarius Carde, who now held a station equal to and, in some respects, greater than their own; and the little band of Salvarius Carde's followers was dispersing in silence, when a commotion in the gallery brought them all to a halt.

A page hurried in, and knelt at the feet of the retiring Emperor, giving him a message. Dolmician read it; and turning to the throng in the hall, he raised his hand for quiet.

"The translators have already rendered the Tellurian message into our own tongue," he declared: "Return to your places, and they will read it to us."

The murmuring and congratulations ceased. A sea of expectant faces turned upward toward the gallery in strained attention. The eldest of the translators appeared, followed by the others. With heavy gravity they moved to the dais before the Emperor and bowed.

"You have made a fair and accurate translation?" inquired the ruler.

"We have, Sire."

"You have not taken advantage of the fact that no one else here can read the message, and thus give the lie to you?"

For a moment the spokesman faltered, but his reply was steady enough:

"We have not, O Illustrious Emperor."

"Then read the message from the Tellurians!"

The eldest of the translators unrolled a large scroll upon which had been written a hasty text.

"Before I begin, Sire," he said, "I want to explain that ours is a very compact language, compared with that of the Tellurians. Consequently, what they took pages to write, we have here been able to render into two or three paragraphs. They are as follows:

"'Mourn not for us, O other peoples of the Universe; for we of the planet Tellus have chosen to die by our own hands in shame because our bodies and our minds are neither so beautiful nor so powerful as the bodies and minds of the planet Pleida.

"'For many generations we were a happy people, but now we are wretched with jealousy. A band of our explorers, cruising the ether, landed upon Pleida, and brought back such reports of the beauty of that world, the strength and intelligence of her people, the justice and might of her Emperor, the strictness of her laws and the mercy with which they are administered, that we are consumed with envy and despair; and we have chosen to die and leave this planet for habitation by those mighty beings, more worthy than we.

"'So, if any men from Pleida find this message, and bear it away, and translate it, take it with our greetings and felicitations to the great Emperor Dolmician, and tell him that this little world is his to do with as he pleases, for we are relinquishing it to him!'"

When he had finished, the translator rolled up his scroll again, fastened it dexterously with a bright ribbon, and handed it to the Emperor. The nobles applauded thunderously. Dolmician beamed.

"Well, now," said he, "That is a noble message. These Tellurians must have been a fine people, after all!"

Allus Marce, with the rashness of youth, raised his arm for permission to speak. It was granted him.

"But what do the Tellurians say with regard to the absence of all water from their earth?" he inquired.

The translators appeared confused, and avoided his eyes and those of Salvarius Carde and the other voyagers.

"As a matter of fact," said their spokesman at length, "The message does not mention the subject, as you have observed. The Tellurians, in paying this compliment to our mighty Emperor, did not bring up the matter of water at all."

"And quite rightly," chimed in the Emperor, turning his ring back again toward his palm, and dismissing the audience: "I will have this transla-

tion framed for the public hall; and the metal cylinder and the original sheets shall be placed in the Royal Museum."

Allus Marce, with the others, passed out into the street. He said nothing, but his body was trembling with anger and indignation.

CHAPTER V

The House of Allus

AROUND the ancient sun wheeled the planet Jupiter (known to its inhabitants as Pleida) making his journey once in eleven years ten and a third months, as time was once measured on Tellus. His great volume, more than thirteen hundred times that of the tiny, dead planet, marked him lord of the solar retinue. His cold journey through space was performed eternally at a distance of nearly five hundred million miles from the source of his light. Yet his face was not chilled, for from his heart came the great warmth of inner fires; which served eternally to keep his inhabitants at liveable temperatures. This was similarly true for his larger satellites.

These companions were nine in number, four of which were inhabited. The largest, called by its inhabitants Neina, had a diameter of 3,550 Tellurian miles, exceeding the planet Mercury and approaching Mars in size. Another, called Quena, measured 2,100 miles in diameter; and thus was somewhat larger than the single moon of Tellus.

Upon the satellites existed the highest and oldest civilization of this strange system of moons and mother-planet. Upon Neina had developed that unique race of winged beings which later inhabited the four greater satellites, and finally, even Pleida itself. But now was Pleida the ruler, and the satellites were subject territory in government as well as in physical relationship. On the larger body, the race not only had grown rapidly and prospered but, yielding to the subtle influences exerted by the tremendous gravitation, the hot, damp climate, and the great distances, had changed to a brutal and selfish character, interested only in ruling and in military prowess.

From this branch of the race had sprung Salvarius Carde and like other native Pleidans he was short and sturdy, heavy-boned and phlegmatic. But Allus Marce, slender and refined and of a certain delicacy, as befitted a native of the small, light satellites, had come from Neina. It might be said that, although Pleidans had little difficulty in navigating the surface of the moons, the inhabitants of the moons were obliged to have the intense gravitational pull thoroughly nullified by portable apparatus before they could travel over Pleida.

Not long after the scene at Dolmician's court, on a day when anger was still seething within him, Allus Marce stood upon the polished floor of the audience room in the house of his father. Before him, on a raised dais, the aged patriarch of the House of Allus sat enthroned in a chair of bright metal, with the robes of his degree and the seal of his authority upon him; for the family of which he was the head had vast estates, and ranked among the greatest nobility of the four moons.

The old man raised a kindly, withered hand.

"You have now wandered farther afield than any of the illustrious line of Allus before you," he began: "You have surveyed the stars in their courses; you have trodden planets where never a native son of the Pleidan system had planted his foot before. You have breathed the air even of far-off Tellus; you have flown over her wasted surfaces. Such adventurings should cure the most insatiable wanderlust."

The young man nodded: "And yet—" he said.

"Not satisfied, after so much?" The patriarch raised his eyebrows questioningly: "Don't you think it time that you prepare to take up my work here, since I shall soon be compelled to relinquish it? Is it not time that, as heir to the headship of Allus and its properties, you took a sterner view of life?"

Marce cast his eyes down, unwilling by word or gesture to anger his father or to betray how little he regarded the sacred and age-old functions of a family head. Compared with the more glorious existence of discovery and exploration, it seemed flat and tasteless; as though a strong man should voluntarily undergo the amputation of his wings, so that always thereafter he must walk instead of fly, creep on the ground rather than beat out the *elons* magnificently in the sky.

"But I am still young—" he objected.

The patriarch regarded him critically through half-closed eyes, turning over in his mind many quiet reflections.

"Youth," he said at length, "is no excuse, except perhaps for inexperience. You are young—yes! But it is time, nevertheless, that you took to yourself a wife and settled down to the care and understanding of your life's duties, bringing forth heirs to the House of Allus."

"I don't want a wife," Marce replied, his face flushed with emotion: "In all Pleida I have not seen a woman I wish to marry!"

His father smiled indulgently.

"Where else, then?" he inquired: "In all your travels to other worlds—have you seen anyone whom you'd marry rather than the women of your own race?"

Marce shook his head. "But I have heard of one," he said bluntly: "I have heard of one whom I would marry, if she would have me—and if she still lives."

"What?"

"The fact is," said Marce, turning the subject, "I am not yet ready to settle down. I know what you think—that I'm no good, that I haven't the courage to manage your estates, that I'm a weakling and worthless as an heir. Actually, it is because other considerations trouble me that I cannot give up my freedom now. Father, I tell you this: my visit to Tellus has fired me with determination to visit it

again. There is a mystery in Tellus which has not been solved. I cannot reconcile the disappearance of all its water and its race of men as well, with the legend preserved in our family that, not so very long ago, Tellurians visited us, staying beneath this very roof as our guests. Why did the Earth-race die out so quickly? What has happened there?"

"Why didn't you satisfy yourself while you were there?"

"With Salvarius Carde in command?" Marce's voice trembled with his pent-up anger.

"Why not? He is a soldier and a gentleman."

"And a thief and poltroon as well, who covers himself with glory at other men's expense!"

Marce Tells All

THE patriarch suddenly became dignified and cold; as though the attitude of his son toward one so greatly honored by the Emperor had appeared also a personal affront to himself.

"You will remember," he said, "that Salvarius Carde is now a ranking noble, and as such deserving of your respect; however much you may in private doubt the wisdom of the Emperor in so honoring him. Further, it would be well for you to keep in mind that, only after repeated urging on my part, Salvarius Carde, who is my friend, took you with him on the trip. He felt that you would be too young, that you would be a hindrance and a source of danger. You should show gratitude, at least!"

Allus Marce listened patiently, but his eyes were blazing.

"My father," he replied, "for all these things which you have done for me, and for all the things Salvarius Carde has done for me, I am indeed greatly indebted. But has Salvarius Carde reported to you, since our return, whether I was a help or a hindrance on the expedition?"

"No, he has not."

"Neither did he mention me, or anyone else in the expedition, to the Emperor; but rather sought to take all the credit and all the glory of the whole trip upon himself."

"Well?"

"The fact is, my father, that it was I and not Salvarius Carde who discovered the message-cylinder. The leader of our expedition, who took so much credit upon himself, was never near the place; and neither was any other member of the party. The 'facts' as reported by Salvarius Carde to the Emperor were false and distorted; and all the other members of the expedition know it. They are now afraid to tell the truth, only for fear that Salvarius, the nobleman and your friend, would harm them for it. I tell you, father, just as these Pleidans here borrowed our music and our art and made such dull, flat things of them" (no Pleidan is naturally musical) "so they wish to steal the glory due us."

The head of the House of Allus stared speechlessly at his son. Then, rising from his chair, he stood like a tower of white flame upon the dais, resentment and wrath in his every gesture.

"Marce, is this thing you have told me the truth?"

The young man nodded silently.

"And can you bring me proof of it? Will the others of the expedition, if secretly questioned here, bear you out?"

"The members of our own race will. The Pleidans—I can't answer for them."

For many generations the people of the satellites had been ground down by the despotic Pleidan rulers who had gained control over them. They now groaned beneath their burdens—the cruelties, the inequalities, and the frequent plundering expeditions of the nobles of Pleida. The Pleidans had fallen into a contemptuous attitude toward the satellites and their peoples. Neina they called by the undignified name Noninus, a diminutive with a somewhat deprecatory meaning. The other satellites received similar slurs; and were forced, as well, to pay tribute to the Emperor and to be forever at the mercy of his capricious will.

As the result the inhabitants of Neina and those of the other moons had developed among themselves a fierce, secret pride. The inhabitants of Helva, the fourth moon, had in fact repeatedly rebelled against the authority of the Emperor; and such fierce fighters were they that, despite the power and wealth of the Pleidan armies, they had actually set up self-government of a kind, though it cost them heavily in men and wealth to maintain it.

(To Be Concluded)

What Is Your Knowledge of Science?

Test Yourself by this Questionnaire

1. How much of the light and heat of the sun does Jupiter receive, per unit area, in comparison with the light and heat received per unit area by the earth? (Page 775).
2. How much would an object weigh on the surface of Jupiter that weighs one pound on the surface of the earth? (Page 783).
3. How long does it take Jupiter to make one revolution around the sun? (Page 786).
4. What kind of disturbances are caused on the earth by sun spots? (Page 791).
5. What, according to Bode's Law, should lie between the orbits of Mars and of Jupiter? (Page 821).
6. What is the shortest distance between the earth and the planetoid Eros? (Page 821).
7. What is the gravitational acceleration in meters per second in a vacuum of a body near the surface of the earth? (Page 841).
8. A body weighs one pond on the surface of the earth. What would it weigh at a distance of one radius from the earth? (Page 841).
9. What has Professor Charles Brush discovered in his experiments with gravity? (Page 841).

Can Man Fréé - - - Himself *from* Gravity?

By Dr. Th. Wolff
(BERLIN)
(*Translated by Francis M. Currier*)

AMONG the many fantastic dreams of world-stirring inventions—dreams to which both the learned and unlearned have been subject from time immemorial—there is the hope of liberating mankind from gravity. In truth, it is gravity, that mysterious force which is to-day as complete a puzzle to physicists and philosophers as it was centuries ago, which chains man to the earth with unescapable power, making him an inseparable dependent and even a slave of our globe. Oh, if there were only no gravity!

In that event, the problem of flying would be so perfectly solved that our present aviators would become green with envy. There would be no need of any flying machine or airship or motor or apparatus of any kind, in order to rise into the air to any desired height. A man freed from gravity would need merely to push himself from the ground with his foot, and he would at once float high into the air, as high and far as he might wish—even far beyond our atmosphere and into space. He would be freed from the chain which, in our present lamentable condition, sooner or later pulls back to earth everyone who rises above the surface of the earth. Stairway, ladder, and elevator would alike be superfluous. With a little shove anyone would reach the highest window of the highest skyscraper, gliding in pleasantly. On this excursion he could also take along a wagon-load of baggage.

Is is any wonder that inventors and discoverers have long sought to realize the dream of freedom from gravity? Indeed, such attempts have often been made. They consisted mostly of trying to discover a substance which allows the radiations of gravity to pass through it. Just as glass allows the light rays to pass through and thereby retains no light-energy, a substance of the mysterious kind sought is supposed to become weightless itself by allowing the gravitational rays to pass through it. Other inventors imagine a solution of the problem in a different manner and, in fact, there is no limit to inventive genius and imagination.

From time to time the newspapers inform us that such and such an inventor has succeeded, at least partially, in solving the problem. Usually, it is an American professor to whom rumor (or falsehood) attributes this startling discovery. Repeatedly news came out, of a Japanese physicist who was supposed to have succeeded. And, a few years ago, this novel discovery was reported to have been made by a learned negro.

Our credulous fellow citizens of the world have also ascribed this discovery frequently to inventors of repute. In 1879 it was reported that Edison had made an invention for eliminating gravity. It was said to consist of an apparatus or a substance which, when worn under the clothing, would free mankind of weight. I cannot say whether Edison actually did busy himself with this ingenious idea and told others about it. It is perfectly possible; for the "Wizard of Menlo Park" has repeatedly come before the public with inventions which have proved to be products more of imagination than of possibility. At any rate, at that time there was a rumor current of Edison's "Anti-Gravitation"; and a witty cartoonist of the time took advantage of this helpful substance. His picture shows amusingly how the visitors to an art gallery, all provided with this invention under their clothes, would readily swim up to the very highest pictures. They are even able to float on their backs, in order to view the paintings on the ceiling.

But serious scientists have concerned themselves, at least casually, with the discovery of freedom from gravity. It might be mentioned that the philosopher and physicist Lasswitz (often called the "German Jules Verne") made a fictional solution of this problem in one of his many scientific stories. This story takes place on the planet Mars; and the Martians who, according to Lasswitz are far ahead of us in civilization and science, have also discovered the secret of freedom from gravity. They are thereby in a position to fly easily through space and to come from Mars to the earth. It is evident that this fantastic problem has as much interest for the man of exact science as for imaginative inventors and newspaper reporters.

Of late, also, the news of such an invention has been in the papers. An American physicist, Charles Brush by name, was reported to have succeeded in finding substances which, even if not free from gravity, can still effect a reduction of its force. It is common knowledge that gravity acts in this manner: any body near the surface of the earth, of whatever substance it may consist, receives in a vacuum an acceleration of 9.801 meters a second toward the earth. The materials of Professor

Brush's experiments—said to be silicates of a definite composition thus far known only to the discoverer — were reported to have shown an acceleration in falling of only about 9.2 meters a second. This indicated a lessening of the acceleration of gravity to the extent of 60 centimeters a second. If true, this would be a fine achievement; and by increasing the valuable property of these mysterious substances one might perhaps attain approximate or even complete freedom from gravity. Let us wait for it!

THE following article "Can Man Free Himself from Gravity!" by Professor Th. Wolff, has been translated by us especially for "Science Wonder Stories."

In order to answer Dr. Wolff's emphatic statement that man can never conquer gravity or even get beyond 400 Kilometers above the surface of the earth, we invited members of our Board of Associate Editors to write us their opinions on this very interesting subject.

We print these letters without comment except to call attention to the fact that for the most part, although man has not yet devised the means and apparatus to free himself from gravity, it is recognized that we know so little about the nature of the matter that it is foolish to say that such things are mere chimeras or that they are impossible of ever being realized.

We are sure our readers will read with a great deal of interest and illumination these serious reflections of eminent scientists.

What says science to the problem of freedom from gravity—science, which thinks more modestly and in general more exactly than the revolutionary inventors? According to science all these ideas are to be relegated to the realm of dreams or of baseless imaginative fancy. The weight of bodies near the earth is conditioned by the attraction of the earth; and, since the earth attracts all terrestrial bodies without exception and since this attraction is the same for all bodies, gravity must be the same for all bodies. An exception to this rule would be in irreconcilable contradiction to all our observation of nature; so that even the newest American discovery which we mentioned must with absolute assurance be relegated to the realm of fiction. If there were exceptions and deviations from the general law of gravity, these would certainly have appeared before now in manifold and various ways, and it would not need the discovery of mysterious substances to bring them to our knowledge.

To be sure, gravity, or the force of attraction of the earth, is not constant. A body at the equator weighs somewhat less than the same body weighs at the north pole. This is due to the fact that our earth is not a perfect sphere but is flattened at the poles. Accordingly, bodies at the poles are somewhat closer to the centre of the earth, which is the centre of gravitation. Furthermore, according to Newton's law of gravitation, the weight diminishes with the distance from the earth. At a distance of one radius from the surface of the earth a body would weigh only one-fourth as much as on the

(*Continued on page* 841)

Limit of 400 Kilometers Is Wrong

By PROFESSOR R. H. GODDARD

CLARK UNIVERSITY

DR. WOLFF is correct in saying that there is little likelihood of discovering a screen for gravitation; for this would be equivalent to discovering perpetual motion, which we know from wide experience in physics is impossible. The use of such a screen would enable a heavy weight to be lifted without effort, this weight doing work when falling after the screen had been removed.

Also, the transforming of our familiar gravitating matter into non-gravitating or weightless matter would involve great energy changes which do not appear possible. For example, a pound mass at an "infinite" distance from the earth would have a potential energy so great that when it hit the earth's surface its temperature would be raised thousands of degrees; whereas a pound of weightless matter would not have this energy.

The statement, that the extreme limit of height that can be attained with fuel at present available is about 400 kilometers (250 miles) above the earth's surface, is entirely wrong; for it does not take into account the possibilities of the multiple-rocket principle. This consists in the use of a series of rockets, one above the other, and each one a copy in miniature of the one below. So far as I know, I was the first to suggest this idea; it was incorporated in a manuscript submitted to the Smithsonian Institution in 1916, which was published in the Miscellaneous Collections of the Institution in 1919.

The importance of the principle may be realised by the following example: suppose there are three rockets, placed one above the other, and each one is fired as the one below becomes empty. We may make each smaller than the one below; in such proportion that each rocket imparts the same additional speed to the rockets that remain.

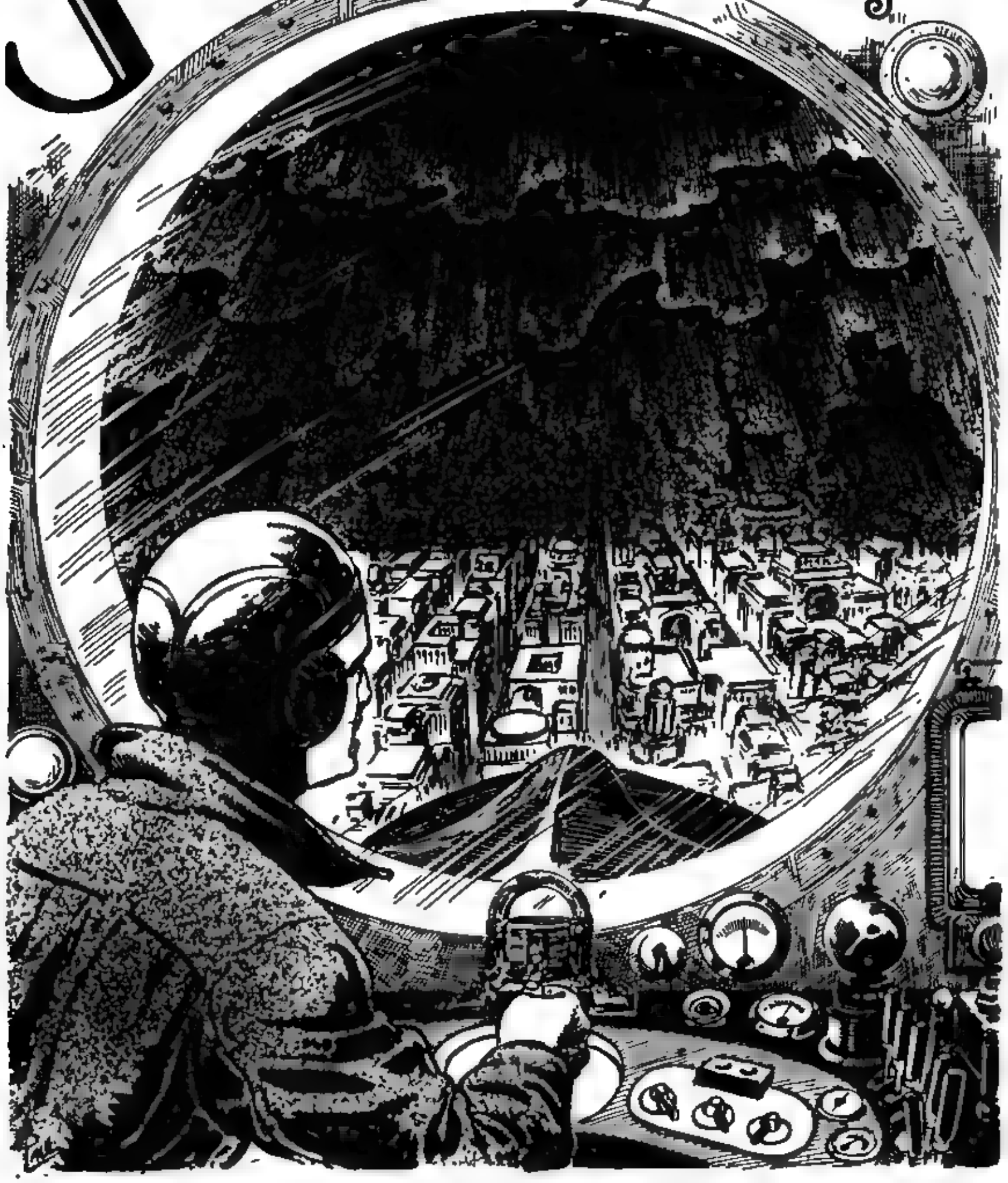
The last rocket will have a high speed; and this speed would be twice as great if six rockets had been used, and would be three times as great if nine rockets had been employed. In fact, the only limit to the speed of the final rocket is the total number of rockets; so that the height reached depends more on the total number of rockets used than upon the fuel. Of course, the lower rockets will be enormously large if the number of rockets is very great, which is the reason why a fuel having as high a heat energy as possible should be used.

The importance of this principle in reaching very great distances from the earth is not yet generally understood; and the idea has consequently been criticized somewhat abroad.

R. H. Goddard

Streamers of Death

by Henrik Dahl Juve



(Illustration by Paul)

He noticed now that the waving streamers were blacker than the night that surrounded them. The black streamers were now so dense that the stars low in the southern sky were hidden as by an impenetrable screen of black smoke.

IN the laboratory of the Fenwich Medical School in Portland, Oregon, Buford Renshaw was working one night. Before him was an array of dissecting tools, microscopes, electrical apparatus and bits of frogs' legs and human tissue. Beside his table stood a therapeutic poly-sine generator, another table was littered with odds and ends of radio equipment.

Having completed his medical course, Buford had undertaken post-graduate work in psychoanalysis and neurology. He was now working late into the night determining the effects of varying strengths of electrical and other currents upon the nerves and muscles of his specimens. Conversely, he was trying to pick up nerve impulses and interpret them in electrical terms. These experiments were necessary to the perfection of an invention on which he had been working.

HENRIK DAHL JUVE

At last he straightened up from the microscope into which he had been peering intently, stretched his athletic body, and glanced at his watch. It was almost midnight. He made some entries in his notebook and then reviewed several pages with a smile of satisfaction. He was making progress; such progress as he had not dreamed of. In fact, his discoveries might well startle the scientific world and make him famous overnight. But he was not quite ready for that. He put away his notebook and paced the floor. His mind leaped ahead to the possible results of his invention and discoveries. He was reluctant to leave the laboratory at this stage of his experimentation; but he would have to wait until he could produce more equipment from a down-town radio store. There was nothing left to do but to go home and get some sleep.

Gathering together the perishable elements of his paraphernalia, he carried them to the dissecting room and lowered them into a vat of antiseptic, there to rest with his other gruesome specimens. Making sure that everything was in order, he turned off the lights and left the building. He locked the door carefully, jolted a cigarette from a package, and sat down on the steps to wait for his trolley car.

Buford drew his coat tighter about him and gazed up into the clear, cold sky. The stars blinked down at him boldly, now that there was no moon to dim their lustre. He now let his thoughts wander a little, in relaxation after his intense concentration. He thought of the constellations. Why did the astronomers use so many snakes, scorpions, dragons and other unpleasant animals for celestial figures—why not something lovely? Helen DuMar, for instance.!

Idly his thoughts turned to her and he tried to place her pretty face among the stars. But the street car ground and squealed its clamorous way around the turn, and gathered speed again down the street. Buford took a last long drag at his cigarette and flipped the short stub far onto the lawn. Placing his hand over his coat pocket to keep his precious notebook from jumping out he ran to the corner and, without waiting for the car to stop, swung aboard.

Buford Investigates

HE dropped off the car at Massachusetts Avenue, on the East Side, and proceeded to walk briskly the five blocks northward to his home. At a corner he noticed a man standing in the street looking toward the southern sky; another stopped to stare. The first ran into a house and presently returned, followed by several others, who all stood gazing into the southern sky. Buford thought with a grin of the time he himself had, by way of experiment, stopped on the corner of Fifth and Stark one busy day and gazed intently upward; he soon had several hundred openmouthed people staring with him at nothing. Dismissing the thought, he hurried on.

There was a scurrying of people. Someone shouted. Dark windows in dark houses suddenly blazed with light. There was a slamming of doors and, gradually, the street filled with people clad in hastily-donned bathrobes and slippers, all looking intently toward the south. This was too much for even a psychologist and Buford glanced casually over his shoulder, stopped short, and spun around to join the others.

His first thought was that Nature was up to one of her usual caprices. Apparently she had shifted an exceptionally brilliant

IT is surprising how little that we know even in this day of advanced scientific knowledge, about our life and the circumstances that govern it.

Some things that affect our lives vitally, such as the cosmic rays, represent phenomena of whose nature we are almost entirely ignorant. In the interaction of the physical, electrical, chemical and other forces that govern the solar system of our world, we are helpless.

Sun spots cause violent electromagnetic phenomena that cripple our electrical communication systems. The Aurora Borealis, said to be caused by sun spots, is even in this day only imperfectly understood; while there is no doubt that it exercises an effect on our life of which we are only dimly aware.

There lies before us the almost-untouched field of what we may call universal electromagnetic phenomena. If anyone could understand and control these phenomena, he would exercise a powerful influence on the life of our universe.

This is the subject that Mr. Juve takes for the exercise of his versatile talents.

Aurora Borealis to the round, jovial, belt of the earth, and now the scintillating streamers darted up from the south and traced a weird pattern in the tropical skies. Now he understood why people stood about and whispered in awe. Buford recovered somewhat from his astonishment and his thoughts raced—forming and rejecting ideas to find an explanation. One idea loomed above the rest and urged him to thread his way hurriedly up the street to his home. He decided that this astonishing phenomenon was too interesting and unusual to miss, and that he must ascend a mountain that he might view it better. From long laboratory training he glanced at his watch as he ran. Twelve-thirty; no doubt the strange lights had begun about midnight, while he was still on the car.

He found his parents out on the front porch, and stopped to explain his purpose. He paused for another look at the weird display and was startled to find that the streamers had become so bright that surrounding objects cast vague spectral shadows. Now he noticed, for the first time, that the faces of the people about him appeared a hideous, doughy, white—as though they had been dead for some time. At once he understood that there were no red rays in the light; but this knowledge did not detract from the gruesomeness of the scene. He explained the reason for the ghastly coloring to his parents and then hurried to the back of the residence where his airplane reposed in its hangar. As he ran he heard a panic-stricken woman emit a blood chilling, death-like shriek. Others caught the panic of mortal terror and sent it re-echoing into the night.

Quickly Buford flung open the doors of the little hangar and crawled into his "flivver" type, torpedo-shaped craft. He slammed the door and strapped himself into the pilot's place. A luminous-painted switch handle glowed spectrally in the darkness. He slammed the switch shut, thus connecting his ship with the powerhouse from which he derived power by radio over the second ether. This was a new discovery and improvement over the old first or "Chemical Ether" radio. Another switch closed and there came a faint hum as the power for the gravity nullifier was being generated. Slowly, lest the change effect his blood too quickly, he moved the lever that varied the strength of the nullifier, gradually bringing the nullifying force up to full strength. As he waited he looked out of the low, streamlined, glass conning tower at the shining metal hull of his thirty-five foot sport ship and reflected that the second-hand job had been a great bargain.

But the eerie light that was reflected back from the surrounding buildings, making his plane look like a ghost ship, brought his mind back to the mysterious phenomenon; and he moved the lever faster perhaps than was good for his system. He recovered from the slight dizziness and snapped on the dashlight an instant to see that everything was operating properly. With the cabin in darkness he switched on the searchlight and brought the nullifier up to strength. The ship eased upward, and he closed another switch connecting him with the power house from which he borrowed potential energy. With one dart the little plane flashed out of the hangar and went straight up, until it was well above the surrounding obstacles. Buford swung the ship around and placed it in a steep climb at full speed on a course north of east. In less than three minutes he dropped the ship gently on the top of Mount Deer. Quickly he opened a locker and pulled out a heavy fur overcoat, a cap and mittens, which he hastily donned. Then he crawled out of the machine.

A magnificent panorama spread out on every side. The lights of Portland twinkled in the south and several other towns and cities gleamed and flickered about him. But to the south! Like a solid line of powerful searchlights playing over the sky, the amazing Aurora had brightened until his surroundings stood out as if etched in bright blue moonlight. It was beautiful and ghastly. He noticed that the red license number on his ship now showed, not black, but dully red. The light was now emitting rays of red.

The New Aurora

BUFORD took the television screen and radio reproducer from his ship and set them on a convenient rock. After connecting them to the receiver by extension cords, he tuned in on the news service. He could not alternately watch the screen and the weird lights while he listened to the reports over the speaker.

He learned that the entire populace of the western hemisphere was in the streets and on the housetops. Scientists had hastily adjusted their instruments for observations, and thousands of spectroscopic photographs were being made. And at the astronomical observatories, instruments were adjusted and careful readings taken. News reporters rushed their air taxies to the laboratories of the scientific leaders, clamoring vainly for interviews with the great men who labored behind locked doors.

For unaccountable reasons riots broke out in some sections of the cities, and the ignorant classes were mad with fear. Views of terror-stricken mobs were flashed upon the television screen, and Buford was appalled to see the thin veneer of civilization stripped from the people and the animal-like savagery beneath assert itself.

Buford glanced at his watch. It was one-thirty. The lights were now assuming a definitely pinkish cast and becoming still brighter. As he sat on the mountain top in lonely vigil he was so fascinated by this weird display that he almost forgot to take notes. Gradually the lights became red and yet a brighter red. The earth was bathed in a strange radiance of reddish pink light. The people seen on the television screen were ghastly, because there were very few of the shorter rays in the scintillat-

ing streamers. The rays of light had now broadened; they waved and billowed lazily like huge flags undulating in a slight breeze.

At last, at one minute after two in the morning, the International Television Service carried the report of a short interview with the head of the Lick Observatory. According to the report, the new phenomenon had all the characteristics of the Aurora Borealis and it was concluded that for some unaccountable reason the phenomena of the Aurora had shifted to the equator. Scientists were at a loss, thus far, to account for the unusual happening and for the gradual change of color from violet to red. It was supposed that it had begun as ultra-violet light. The report went on to state that the light was now so bright that it could be seen dimly by the inhabitants of the now lighted portions of the eastern hemisphere, especially where the sun was hidden by clouds. Buford finished listening to this account and settled back to enter the gist of the report in his notebook when his radio telephone bell rang. He crawled into the ship and took down the receiver.

"Buford Renshaw speaking," he spoke into the instrument.

"This is Helen. Tune in your television so we can see each other. I'm so frightened!"

"Just a moment. I had the screen outside."

Buford carried the screen inside, dragging the extension after him. He made the necessary adjustments and Helen's face appeared. She was calm but her eyes betrayed anxiety.

"I'm the only one at home and these mechanical servants are not much company. Daddy has been in his laboratory since noon. I wish you could come over. Is there any danger? I know it's silly to feel that way, but those lights are so sinister that I just can't help myself."

"I don't think that there is any more danger than from the northern lights, although this is something entirely new. I'll be down in a few minutes. I'd like to take a few more notes first. I am on the top of Mount Deer and have a fine view from here."

"I'll be looking for you—and hurry!"

Buford tuned the televisor back to the news service just as the typewritten interview was switched off, and the pickup gathered in a view of the people in a section of the down town district. He saw them hurrying out into the street after reading the report on their televisors. The strange panics were now subdued by the militia called out to keep order.

The change that was taking place in the sky was now uncanny. The Aurora had assumed the bright color of new blood. The whole earth assumed the color of blood. There was something sinister and gruesome about this blood-colored light waving and twisting, silently and mysteriously. Even Buford felt his scalp tighten and his blood chill. He closed his eyes to take stock of his own physical condition, but concluded that the lights were having no visible effect. He renewed his observations with new assurance. Gradually the red light darkened until it assumed the color of dried blood and a hint of purple suffused it. The televisor showed crowds of people now frantic again among whom the inevitable words had flashed: "The world is coming to an end!" They crowded the streets of the cities —terror-stricken but impotent. Churches were filled with people who knelt and prayed while they looked apprehensively over their shoulders. Again and again through the pictures he saw men and women suddenly become raving maniacs and slash about like fiends before they were subdued by saner companions. The cities had become pandemoniums—seething, raving madhouses.

CHAPTER II

The Black Streamers

FIRES broke out in several parts of Portland and the televisor showed fires in other cities. It was reported that these had been set by pyromaniacs whose instincts had been set free. The government leaders were broadcasting words of confidence, and this managed to help matters to a certain extent. But these efforts were too localized and too impersonal to affect a number of persons terrified by the weird happenings.

Buford watched the pictures on the screen with growing apprehension for Helen; but he was unable to tear himself away. There was that quality about the darkening lights that seemed to fascinate him and hold him for a moment longer, and then another moment, and another. He watched the streamers become a hideous, reddish purple and gradually turn black. A chill of death swept through him as though a wind were blowing, a psychic wind that moved nothing but chilled the blood in his veins. He struggled desperately to fight off the growing panic; trying to analyze his feelings in order to regain control of his actions. He found that by forcing his attention to the abstract and concentrating upon the causes of this terrifying display he was helped immeasurably. Methodically he began to write notes.

Again the uncanny chill swept through him and he concentrated deeply to avert tragedy. He noticed now that the waving streamers were blacker than the night that surrounded them. Another amazing phenomenon presented itself. The northern Aurora Borealis began to blaze, becoming brighter as the Southern Lights became blacker and denser. The black streamers were now so dense that the stars low in the southern sky were hidden as by an impenetrable screen of black smoke. It became denser and blacker; finally Buford fancied that he heard a crackling sound. It seemed that the very air was now bursting asunder.

Another scientist now made a report, this time over the radio telephone, stating that they were still at a loss to explain the extraordinary events. He referred to the southern lights as composed of

"negative light." There were no harmful pathological or psychological results possible in it, he said glibly. In the laboratories, guinea pigs were being carefully observed. And unable to see the lights the pigs were not terrified. Therefore, the scientist reasoned the whole power of the phenomona was optical. Scientists were speculating as to the reason for the sudden looming up of the true Northern Lights. They were at a loss to analyze the negative light, having no instruments with which to make any observations. Another interesting phenomenon was that no radio or power communication existed across the equator; and the cities whose lighting depended on this were now in darkness. In these cities, from what reports emanated, the people had become quiet with despair. Psychologists were gravely concerned over the results of this powerful fear, and were already working upon plans for the elimination of the suppressed terror as soon as the phenomenon should cease. It was further stated that this curtain of negative light could be plainly seen on the lighted side of the earth.

Buford returned his apparatus to the aircraft and got into it himself. He took notes as he listened to the latest report, at the same time watching the southern "lights" become denser if such a thing were possible and the northern lights brighter. The world was now bathed in the eerie glow from the north, which had become so bright that he could read his notes without even putting on a light. At last the northern lights seemed to reach a high point of brilliance, which they maintained while the southern pall of suffocation became still denser.

It was now that Buford noticed a terrifying change. Gradually he felt his mental processes blocked. He felt vaguely and then more strongly a curious inability to think, his perceptions became dulled, as with a fine dust. He gazed at the negative light; he saw it, but that was all. He ceased to wonder. Fear of the southern lights began to penetrate through him and he felt slowly frozen with a nameless terror; an icy blanket that was gradually suffocating him in its hideous folds. His limbs became paralyzed. Animal-like, his tongue lolled out of his frothing mouth and he gasped for air. Frantically he tried to lift his arms to tear at his collar to free his throat but he was helpless. As in a nightmare, phantoms arose and glared at him with terrible eyes. These things though intangible were strange and horrifying. All vestige of consciousness was being dragged from him. His last mental impression was that the blinking lights of Portland had flicked out.

Buford Ponders

WHEN Buford regained consciousness he found himself on the floor of his ship. He felt weak, but slowly, as he lay there, there came an influx of vitality. It was as though the process of his disorganization were reversed, and as though he were being put together after having been taken apart. He struggled and gasped for a while, but gradually the distress left him and even the power of thought returned. Slowly he rose. Looking toward the south, he perceived that the curtain of negative light had gone and the stars were again visible. But the lights of Portland and all the towns he could see were still out. Presently these flashed, on and then went slowly off as though the generators of the power plants were trying to get up to speed.

One thing that puzzled Buford was that the Northern Lights continued to blaze brightly.

Gradually his strength returned. He felt almost normal again. And now the Northern Lights began to fade, rapidly at first and then with lingering slowness, until they were almost gone. It was then that Buford felt his power of thought return. He became fascinated by the new theories that raced through his mind.

As if recalling a dim, distant dream he remembered that Helen had called and asked him to stay with her during this frightful manifestation. And he had, through some fascination that was beyond his power to comprehend—much less disregard—neglected her. He tried to analyze his processes and the nearest he could come was that some hypnotic force had fastened his attention upon the display. Helen seemed to have been blotted out of his memory so completely that she momentarily ceased to exist.

Rousing himself, he clamped the radio loud speaker and the television screen in their places and closed the radio power switch. There was no current. While he waited for power he brought his notes up to the minute writing by the light of his flashlight. He reflected that the whole chain of events seemed like a terrible dream, but there were his notes to confirm his confused memory. He looked at his watch. It was now three-seventeen. Comparing this with the notes in his book he determined that he had been unconscious about twenty minutes.

Buford determined that he would get to the bottom of the affair and learn what freak of nature had cropped out in so terrifying a fashion. He intensified the thought, and while it was vivid, he forced the suggestion into his subconscious mind. This method of subconscious concentration had helped him solve many problems, and he now felt sure that he would play a part in solving this one. In fact, when he relaxed, he knew certainly that he would solve this riddle, although he had no idea as to how it should be done.

Presently the needle on his voltmeter jumped, then moved back to almost zero; and again began moving across the scale. When the voltage was up to normal Buford turned on the gravity nullifier and his craft shot into the air.

It was a strangely-changed world that Buford returned to. He was not surprised to find the people so stunned by the sinister event that even the next day they were unable to return to their nor-

mal life. He found groups about the streets, talking in low tones as though afraid of arousing the monster; and yet seeking company that they might feel some vague semblance of security in numbers. Even grass and flowers, that had resisted the oncoming of the fall, were withered sadly, as by frost. Dogs were slinking about with their tails between their legs. The world was stunned, cowed.

Buford's assurance and calm as he moved cheerfully about the house served to quiet the fears of his parents. Presently his mother was busy about the kitchen while he and his father listened to the reports coming over the radio. Buford had telephoned Helen to find her all right.

A scientist, Admiral Midgard, U.S.N., retired, was in charge of the local committee of investigation, one of which had been formed in every large city and all the evidence available was desired by the investigators. The speaker then went on to tell about the weird phenomenon, repeating substantially what Buford had witnessed and experienced. He added, however, that when the light turned into a black curtain of "negative light", as the gruesome phenomenon was now termed by scientists, those who were on the lighted hemisphere could see it plainly as a black wall. Even the sun could not shine through it, and those living where it intercepted the sun's rays reported that the darkness of night settled over the land. They had characterized it as "the darkness of a pall of death." He told further of the terror of the people and the number of suicides during the time that the light was turning to the ghastly red and the death-like black.

Breakfast was ready and they sat down to the table while they listened to the reports. Presently the speaker announced that a most extraordinary report had come in from the chief engineer of the Columbia River Rapids power plant, from which Portland derived its power by radio. At midnight an unaccountable increase in the load was observed. As the lights increased in brilliance the load increased. So unusual was the increase that the load dispatcher on the night shift called the chief engineer and together they watched the simultaneous growth in intensity of the Southern Lights and in the power demand, making careful notes in the dispatcher's log. When the Southern Lights reached their apparent peak the dispatcher despaired of carrying the increased load and was about to call upon the Boulder Canyon power plant for assistance when a peculiar mental apathy crept over him and he could not recall just what he had intended to do. Nor did he care. All of the crew had lost consciousness shortly after this. But from their recording instruments, it was found that the load had increased until the relays had kicked out the Portland main feeder circuit, plunging the city in darkness. This occurred at about the same time that the Southern Lights were thought to have disappeared. All power houses were called, but none other than the Columbia Rapids plant had experienced any such abnormal demand.

CHAPTER III

The Second Appearance

BUFORD listened to this in open-mouthed consternation. He recalled dimly that the last thing he saw before losing consciousness was the blinking out of the lights of Portland. He became excited and forgot to finish his breakfast.

"That is not a natural phenomenon! Someone is at the bottom of it—but why?" he said, struggling to control his excitement.

He stopped eating and leaned toward the radio listening with intense interest. He learned from the speaker the commission had come to the same conclusion as he and was sending out detectives in a vague hope that they might run down the guilty man or the guilty nation. Orders had been sent to all powerhouses that in the event the lights appeared again, all circuits should be watched carefully, and any that showed abnormal increase should be pulled out.

"Now they are getting somewhere!" cried Buford excitedly. The radio speaker went on to tell his audience that the authorities were now sure that they had the extraordinary menace under control. Buford smiled at this.

Pondering the problem, he felt an overpowering urge to work on his invention. He recognized this as the urge of his subconscious mind working on the problem. Or perhaps it was pure instinct that connected his invention with getting to the bottom of the affair.

Leaving the house he got his ship into the air and flew over to the DuMar mansion to see Helen. He had expected to find her angry despite her cordiality over the phone. But it happened that in the frightfulness of the weird lights, she, too, had forgotten all about him and could therefore understand his position. They discussed the event for a time, but he was so eager to get back to the medical school laboratory that he could scarcely sit still.

"Where is your father?" he inquired.

"He was here for breakfast, but went back to his old laboratory as soon as he had finished. He said that he had observed the lights with instruments and wanted to get his data together. He felt that he might be on the way to arriving at some conclusion. You know how dad is. When he is interested in something he locks himself in his laboratory and won't see anyone. He even disconnects the telephone so it won't bother him."

Buford took his leave with difficulty and hurried downtown, where he landed on the roof of a department store. Here he purchased the radio equipment necessary for his experiments. The store was practically empty, there being almost no customers and very few sales people. And these were standing about in groups voicing their solutions of the frightful mystery that had come over the earth.

Reaching the school Buford landed his ship on the lawn of the science building and went immediately to the laboratory. He was lost temporarily

to the outside world as he experimented with the third and fourth ethers, the fourth being considered the highest in our universe.

It was again midnight when Buford relaxed from his concentration to review his work. His experiments had been so interesting that he had forgotten all about the strange and tragic events of the previous night. Then he heard a shout and looked out of a window that faced the south. There again he saw the lights, dim but unmistakable. Quickly he put away his paraphernalia and drove his ship home.

Moving his radio to the porch of his home he stood there watching the lights and listening to the announcements from the news service. The announcer said that no powerhouse had observed any unusual increase in load on any of its circuits but since the lights had just appeared it was not expected for a time. All operators and load dispatchers were on the alert.

The telephone rang and Buford went inside to answer. It was Helen. She was frightened and wished him to come and get her, since her father was in his laboratory studying the lights; and she was alone in the mansion. It was the work of a few minutes to fly to her house and bring her back. Buford drove his ship at full speed lest part of the power be cut off and leave him stalled somewhere on the way. Together they stood on the porch and watched the lights grow more intense.

As the lights became more brilliant they scintillated and flung their streamers in weird contortions just as on the previous night. The silent mystery of it was maddening. As if by magic people filled the streets and covered the housetops. Most of them were fully dressed, for they had been waiting for midnight with apprehension and were prepared to venture outside into the chill air. They were now expectant; it was common knowledge that when the lights reached a certain intensity, the scientists working on the problem would try to counteract it. How, no one knew.

But suppose Buford thought the phenomenal load on the Columbia Rapids plant had been due to some other cause and that tonight the negative light should continue after they were all unconscious? It struck him, from the fearful effect of negative light, that an extension of the power of the lights would mean death to every living thing upon the planet. Little wonder that the world was tense, breathless with anxiety.

Again, as the people watched, the lights grew more brilliant, and a tinge of the gruesome red crept into them. A great hush settled over the watchers. An ominous foreboding of intangible death filled the air. Buford felt his scalp tighten, and fancied he could almost hear a cracking or humming, but all was silent. Helen crept close to him for protection and he bolstered up his courage according to the age-old formula.

The lights shaded off into the sinister red of new blood and then a hint of dark purple gave it a ghastly appearance of coagulated blood. There passed over the world a chill wind that moved nothing, but froze the blood in the veins of the terror-stricken people. It was as if Death were abroad and the breeze of its black robes were felt everywhere. The light trailed off into the first sinister indication of black.

Buford realized that the tension of terror was becoming almost unbearable and that only violent hysteria or loss of consciousness could result. The critical point was being reached.

New Developments

THE tension grew and Buford could barely breathe. This was the test that would check the only clue they had as to the nature of the phenomenon. With taut nerves he watched for the first gleams of the Northern Lights and was rewarded when a faint glow appeared. The Southern Lights were now black and growing in intensity while those opposite them became more brilliant. Apparently the general theory about the lights was erroneous and the load on the powerhouse had been due to some other cause.

Buford felt the end approaching for he knew that should the light continue much beyond the intensity and duration of the previous night the planet would be but a lifeless world.

Buford began to feel again the terrifying obstruction of his higher mental faculties, when suddenly the whole black curtain collapsed and the death-pall left the air. Gradually things came back to normal and the Northern Lights faded out. It was as if the world heaved a great sigh that seemed to relieve the tension. It breathed easy again. Buford and Helen watched the streets become deserted as the people rushed inside to hear the news over the radio.

The announcer was now stating that power had been stolen from one of the radio circuits of the Boulder Canyon power plant. This had been noticed almost from the first, but for the purpose of study, the power had been left on until the last minute. To preclude the possibility of the operators becoming unconscious before they could open the circuit, a relay was devised in such a way that one of the men held the relay circuit open. Then should he lose consciousness, the contacts would snap together and trip the switch carrying the current to the infernal machine.

Nothing new had been learned except that it was now certain that some intelligence was at the bottom of the affair. The announcer further assured the people that they had things well in hand and could prevent any catastrophe.

The next few days went by without further incident. They were days during which Buford worked over his invention with renewed vigor while detectives and secret service men all over the world were attempting to ferret out the mystery behind the apparent attempt to annihilate life upon the planet. Since all nations had been affected alike

and none had devised any protection against the terrible effects of the light, the idea this was due to the work of a nation was abandoned. And then, the power for the diabolical scheme was drawn from power plants in the United States, and everyone knew that she had no designs upon the territory of her neighbors. Hundreds of suspects were arrested but released on proving they had nothing to do with the "streamers of death" as the lights were now called.

The second week after the weird display a terrific storm came over the greater part of the United States. Rain fell over most of the civilized parts of the world, while in the United States the downpour was heavy and the clouds dark and lowering. During the night the rain become a torrent.

Buford burst through the kitchen door as he ended the sprint between his hangar and the house. Even the short run had soaked him with rain. He had worked late in the laboratory, for his invention was now nearing completion, but he was reluctant to retire. Taking off his wet clothing, he slipped into a bathrobe and slippers and turned on the radio, picking up a station in San Francisco from which he knew he could get pipe organ music even at this late hour. He went back to the kitchen where he searched the refrigerator for a midnight lunch, which he found, and finished off with a big apple. For some twenty-five minutes he sprawled out listening to the lingering strains of the organ—relaxing after a hard day, as was his habit. Suddenly the radio went dead in the middle of a concert.

Quickly Buford tuned in the news service from another city in the hope of learning the trouble; nor did he have long to wait. The announcer stated that the lights had appeared again, but were invisible because of the rain except in a remote region in Mexico. Warning had been quickly sent from there and power plant operators were on the alert. Again the plant at the Boulder Canyon had shown an unusual increase in demand; this time on the wave-length feeding San Francisco. The feeder had been opened, plunging the city into darkness. At the same time the southern lights, as reported from Mexico, had disappeared. The speaker further stated that a double watch was ordered for all power plants, to prevent the manifestation stealing upon the world when the lights could not be seen.

Here was a new possibility with new terror. Buford mulled this over in his overworked brain. Evidently, he concluded, whoever was responsible for the outrageous attempts upon the world had been experimenting on the former occasion and had selected a clear night that he might himself watch the results of his diabolical forces. But now he was in earnest and had attempted to annihilate world's life during a storm, trusting that the phenomena would not be noticed until too late. This was more sinister than anything that had occurred so far. He shuddered as he thought how narrowly they had escaped the death stalking silently and relentlessly in the night. Even while he had been enjoying radio music, its black, sinister mantle was being silently draped over the unsuspecting world.

Buford thought of all these things and then cast them from his mind with an involuntary shudder. He tuned in on some lively music from Denver and presently went to bed, only to dream of phantoms that drifted toward him, glaring at him with eyes that seemed to peer from eternity.

CHAPTER IV

DuMar

THREE more weeks marched into the past but there was no attempt upon the life of the cowed world. Gradually people became confident that the danger was over. But, as Buford learned, the extra vigilance was maintained in the power houses while detectives followed clue after clue to find they ended in nothing. And Buford worked almost day and night upon his invention, until he was but a shadow of himself. He saw Helen only three times during this interval.

"You are just like dad," she complained. "When he is working on something, I scarcely see him for weeks at a time. And you haven't told me what you are working on. Why do you keep it so secret? Even if it has something to do with the solving of the horrible lights you could at least tell *me* what it is about."

"I don't like to say anything about it to anyone until I have it ready for demonstration. It may have nothing to do with solving the puzzle of the southern lights, but my hunch is that it will. But I must get back to the laboratory."

It was a struggle for Buford to keep away from his experiments and a struggle to leave Helen in order to return to them.

On another occasion he encountered Professor DuMar at home and the two discussed the problem over the dinner table. But they could come to no conclusions other than those which had been made public by the radio news service. As they talked Buford could not help thinking what a wonderful father-in-law DuMar would make. He was noted as an inventor, and was internationally loved as a philanthropist.

This evening as they talked DuMar set an adjustment on the switchboard of the mechanical butler and it followed a wire hidden under the floor, much as ships are led into New York harbor, and returned with a box of cigars. They leaned back in their chairs and Buford regarded the other man as they blew fragrant smoke at the ceiling and Helen tuned in some music.

DuMar was a man of average build and weight, dark haired with black eyes that glowed with intense energy. He was a veritable dynamo when it came to work. He realized huge sums of money from his inventions but he used practically all his wealth in erecting great hospitals for the poor. In these institutions every painless, bloodless method

of healing was used, some of these methods being DuMar's own inventions.

In some ways DuMar was peculiar. Although an inventor having to his credit great contributions to the machinery of civilization, he was not of a philosophic disposition nor was he an idealist. He was a materialist in the strictest sense of the word. The science of psychology, the probing into the mind, he regarded as something to be shunned. Another singular characteristic of this world-famous man was that, although he took great personal interest in each hospital while it was being constructed he stubbornly refused to go near the place as soon as the institution was in use. And this procedure was repeated for each of the many institutions he had founded. Because of his great contributions to the world the press politely refrained from commenting upon this peculiarity, although most of the people knew of it.

The authorities had attempted to get him on the committee to investigate the strange phenomenon but he had refused, saying that he could work better in his own laboratory and in his own way. And there were many people who looked to him for the ultimate solution of the ghastly riddle. Despite his outward energy and buoyancy, acute observers detected a strangely incongruous mantle of gloomy hopelessness hanging over him. This queer gloom seemed now to be more in evidence than ever, owing, Buford surmised, to the gruesome fate that had hung like a pall over the world.

It was only on rare occasions that Buford saw DuMar, for the latter was almost constantly at work, either inspecting some hospital under construction, attending some charity organization meeting, or immersed in the mysteries of his private laboratory. And so Buford remembered this as one of the most enjoyable evenings of his experience, especially when DuMar, after a short period of silence following their talk tactfully excused himself and left Helen and Buford to enjoy the rest of the evening alone. DuMar seemed always to be thinking of the comfort and enjoyment of others.

It was the third day after this evening that a new development was brought to light. The General Electric Company reported that a huge electric generator to be driven by a steam turbine was bought by a mining company in Colorado. The machine had been paid for upon their acceptance of the order; on completion the parts had been sent by air freight, loaded on a barge nullified against gravity, and towed by an air tug. The firm had sent an expert to Colorado to oversee the installation of the machine, but he was unable to find any trace of the mining company, nor was he able to locate the generator. Detectives had found the captain of the air tug but all the information he could give was that another tug had relieved him of his load and he had returned to headquarters. He stated further that there were only four men on the tug that took the load and that the tug did not bear a license number. He had thought this queer, but had not objected since they gave him a sum of money covering the value of the barge with the understanding that upon return of the scow the money should be refunded. But the deposit had not been called for, nor had the barge been seen again.

A New Lead

THE investigating committees regarded this occurrence as of great importance. For a huge turbo-generator to disappear at any other time would be regarded with interest, but not with suspicion, but at this time it was an event to inspire terror. The local committee of investigation was of the opinion that the fiend was building his own power plant, or at least installing the generator where he had access to a steam plant or steam line.

As Buford listened to this report over the radio a feeling of desperation gripped him. When his new power plant was installed, the destroyer would have an ample source of power under his own command and there would be no hindrance to his effort to annihilate all life. Nor did the news that the secret service detectives and scientists were working day and night to locate the missing unit detract from the gloom and foreboding that had settled darkly over the earth.

After a night of labor at the laboratory, Buford had his invention complete and the model ready for testing. It was a small contrivance which, for easy portability, he had mounted in a suitcase. Wearily he regarded his brain child and reviewed some of the discoveries he had made in the realms of the third and fourth ethers. But there was no time to lose. Rubbing his bloodshot eyes to keep himself awake, he picked up his invention and, not bothering to clean up the littered tables, he locked the door and hurried to the back of the building where he had left his ship. The easy motion of the craft tended to lull him to sleep, but the air traffic was so heavy that he forced himself to keep fully awake. Arriving home he swallowed three cups of strong coffee and then proceeded to test the invention, using his father as a subject. Buford clamped a damp pad electrode on the back of his father's neck and a small pad on his forehead just above his nose. After fitting similar electrodes to his own neck and forehead, Buford closed a switch and made several adjustments.

Presently he seemed to get the right adjustment and stood up in utter amazement. He looked around as though he were transported to another world.

"Why, what's the matter, Buford?" his father asked in some alarm that was mingled with curiosity.

Buford jerked the electrodes off and hastily assembled his kit.

"It worked!" was all he had time to say before he was out of the house on his way to his ship.

The flight to the local office of the committee of investigation was a short one and in the thrill of the success of his invention Buford became wide awake. After landing his ship on the roof of the

building where the local committee worked, he descended in the elevator to the third floor. He had some difficulty in getting past the personnel of the outer office but at length found himself in the presence of Admiral Midgard. The scientist regarded him speculatively while Buford speculated on a way to begin.

Eventually he started detailing the first inception of the germ of his idea and continued with an account of his experiments up to the completion of the instrument. As he talked the Admiral leaned toward him, displaying a growing interest.

"Since, as we all know now," Buford continued, "sense perception is due to impulses over the third ether, I reasoned that a radio instrument functioning in the third ether might be developed to transmit sensation from one person to another. I worked on the idea together with experiments on nerves and impulses until I finally got the instrument, although not perfect, to the point where it worked. And by adding other apparatus I am able to contact the fourth ether and get in touch with the memory of the person."

An Amazing Experiment

BY this time the Admiral was fascinated.

"I, too, had the same idea when the third ether was discovered," he said, "but for the life of me I couldn't figure out the details. You have the advantage over me with your study of anatomy, particularly of the nervous system. As I understand the instrument, it enables one to view the world through the senses and brain of another personality, interpreting these sensations with your own standards and conceptions of color, size and relationships."

"Exactly," Buford replied. "It is as though you were suddenly bereft of all your senses—as though you were living without the senses of sight, hearing, touch, smell, or taste. When the instrument is turned on the sensations of the subject come to you in this dark, soundless world and you see the world through the subject's senses. It is a most amazing experience."

"I can imagine that it is," the Admiral reflected. "Now just how do you propose to use the instrument in connection with the menace that is overshadowing the world?"

In answer Buford opened the suitcase and connected the wires and electrodes. He applied the pick-up electrodes to the Admiral and adjusted the receivers to his own neck and forehead. He felt about with the dials until the right adjustment was found. Then he again experienced what had so amazed him during his trial upon his father. He felt himself suddenly lose contact with the world. He was, as it were, in outer darkness without a sensation of any kind. Then slowly he began to see and feel. This as he realized later were the perceptions of the Admiral transmitted to him. It was as though he were in the admiral's body, and that he had taken on the man's identity. The room appeared, to the Admiral's senses and brain, as interpreted by Buford to be about fifty feet square and thirty feet high. The windows were strangely tall—everything was enlarged proportionately. He could not see the Admiral's face, although he could see vaguely the front of his coat, as one might do without being conscious of it. The retired officer turned his attention to the instrument and Buford saw that he did not know that it was in operation. He, Buford, in the identity of the officer, was trying to puzzle out the details of the construction of the panel. But he understood only a part of it. Presently the Admiral turned his attention to him and Buford saw himself as the officer saw him. There he stood, seemingly very tall, grotesquely tall, with the electrodes clamped to his neck and head. His eyes, he noticed, were strangely fixed and without expression and he sensed that this aroused some interest in the mind of the Admiral. Then the picture became more general again and the Admiral spoke.

"Why don't you turn the thing on?" he asked.

Buford was powerless to answer but he could see himself through the officer's eyes and, as though he were looking into a mirror. However, he reached up with some difficulty and pulled one of the electrodes from his head. Instantly his perception became normal as his own senses returned.

"I was using the apparatus," he explained, "but I was on the receiving end, so you were not conscious of its functioning. Now you try the receivers."

They exchanged electrodes and Buford, now that he had seen his own eyes during the experiment, made the adjustments while he watched the eyes of the Admiral. Suddenly they became vacant and staring and Buford knew that the officer was seeing through Buford's eyes. Whether the other was startled or surprised he could not tell. With the idea of making the picture-like perceptions interesting to the officer, Buford fixed his attention upon various objects about the room. He spoke, commenting upon the amazing results of the machine that the officer might hear his voice. He looked at the Admiral and then took in the details of the officer's person. Eventually he switched off the machine and smiled at the look of utter consternation that spread over the face of the officer.

"Why!" the Admiral gasped. "Everything looked so small that it seemed that I had somehow gotten into a doll house. But when you looked at me or I looked at myself, whatever it was, it seemed that I had suddenly become proportionately small so that I fitted the doll house surroundings. I'm so amazed that my mind is still in a whirl. And when you spoke your voice sounded so faint and far away that I could scarcely hear you. But how do you know that the machine does not distort the impressions that come through it?"

"I put both the receiver and the transmitter on the first time I tried it and found that, although the sensations were double, as though the original sen-

sation caused echoes, these echoes seemed, to an extent, second hand, although they were otherwise perfectly normal so far as I could detect."

CHAPTER V
Examinations

BUFORD then told him how the world looked to him through the Admiral's eyes and they laughed together in amazement.

For the next two days the young man was busy testing the various suspects who had been held. One by one he eliminated them as possible accomplices in the horrible work. He had, for this work, turned on the apparatus that functioned in the fourth ether, giving him access to the subject's memory. The Admiral adjusted the apparatus and then suggested ideas to the subject. Buford therefore experienced all the reactions in the subject to the ideas suggested by the Admiral. In the course of the examination Buford discovered some of the most amazing things to add to his store of psychological knowledge. It was veritable education. But now his object was not study, for time was precious and every minute brought the next activity of the menace closer and closer.

Buford saw the room in all kinds of distorted shapes and sizes—the sizes varying from miniature to auditorium proportions. He understood that each subject interpreted these impressions as normal, but to his mind, trained to interpret only his own sense impressions, they were astonishing. A radical who had once been a barber noticed particularly the hair of those about him. A philosophical shoemaker noticed every shoe in the room. And so it went with each man and his trade and the things that he had schooled himself to notice particularly.

But there was one idea to which they all reacted similarly. When the Admiral suggested the possible cause of the sinister lights every subject associated abject fear and terror with the idea. A few wild theories appeared, but they were of no value. The outcome was that none of them knew anything about the affair, nor did they regard the terrifying lights with any emotion other than fear.

The most amazing thing Buford noticed was when one man was brought in. Black objects appeared white and white appeared black, and similarly for all the colors of the spectrum. Each color appeared as its special complement. Through another subject the world appeared as of one color—red. Another saw the world in monochrome also, the color being blue. It was almost startling to see every object, regardless of its color, as red or as blue. Buford reflected that there was a great storehouse of knowledge waiting for the science of psychology to untangle and classify. The most startling discovery was that to several of the subjects all objects appeared upside down. This and many other physical and intellectual abnormalities was to Buford a source of never ending wonder.

But the examination of the suspects revealed nothing of value to the scientists searching for a clue to the mystery. With desperation, the authorities realized that something must be done quickly. The fiend by now had time to install his power plant, and might elect to destroy the world at any moment. The committee was now as impotent as the rest of the world. Nor did the world know how desperate the situation was, for the invention of Buford had not as yet been made public. The committee considered it a good policy to work secretly and not to give out information concerning the marvelous invention until the world was freed from this fiend and the overshadowing horror. But there was now grave danger that the world would never know of it.

Buford went home that Saturday night weighed down with apprehension. His invention was a big success in its way, but he saw that only by a lucky chance would there by any hope of its averting the tragedy. All of the suspects had been found innocent of complicity with the atrocious actions.

That while relaxing, listening to a musical program on the radio an idea presented itself that made him sit up with interest.

Why not, he thought, use the machine with scientists as subjects, that he might get their complete ideas on the subject and so acquire a symposium of opinions and knowledge from which he might gather something tangible? He was so enthusiastic over this idea that he could scarcely sleep. Next morning he was at the committee office before the Admiral arrived. Waiting impatiently for the officer, he wondered where to start. The name DuMar naturally presented itself as a starting point, for with him Buford was more or less intimate, and this, together with his great name as an inventor and philanthropist, suggested him as the first source of information. And he felt sure that DuMar would lend himself readily to the

What the Test Revealed

WHEN the Admiral arrived he told him of his idea and the head of the committee agreed, but they should first examine a new group of suspects who had been recently arrested. And so for the rest of the day Buford was busy examining and eliminating one suspicious character after another. There were only three left when a mechanic was brought in. There was no positive grounds for suspicion against him but he had been picked up by a detective who felt that he must show his vigilance by arresting some one. The Admiral made the necessary adjustments and Buford put on the receivers from another angle. The switch handling the fourth ether apparatus was closed and the memory of the man became accessible to Buford. Although the man's impressions were blurred—it appeared that his eyes were defective—Buford suddenly became all attention. As the Admiral conversed in such a way as to suggest ideas and lead the way to thoughts of the topic under investigation, Buford had difficulty in reading the pictures

that came to his mind through the brain and sense organs of the subject, but he did get vague pictures of a great laboratory which appeared to be underground. It appeared to have been excavated with a disruptor, that is, the atoms composing the molecules of the earth and rock were split into free electrons and recombined to form water and air. In this way a great cave could be made by one man if necessary, and in a very short time.

At last Buford saw a vague picture of the entrance and found that it was in a hill that had been hollowed out. Nearby stood a huge sawmill. The entire plant was surrounded by a dense forest of fir and spruce. Buford tried vainly to locate the exact position of the laboratory, but could not do so for certain, although he thought, from his knowledge of the surroundings, that he knew what spot the man was thinking of. The conversation drifted to the night of the gruesome light and Buford saw a vague picture, evidently of a hall where there were a large number of men, women and children, all clad in grotesque suits of some metallic stuff. perhaps lead foil. Their faces were covered with masks, giving to the assemblage the appearance of a gathering on a war front after a gas alarm had been sounded. At once an idea came to Buford. If these people were part of the mystery, perhaps their clothing was a protection against the death-dealing light. As he worked his way through the subject's mind, he discovered an idea in it, that life should be destroyed, leaving only such of the inhabitants as were "educated" to certain "ideals" of ethics and sociology. Had not the situation been so serious Buford would have laughed over the parallel between this and the time Noah escaped from the Flood with a chosen few. He wondered if the band that the man evidently belonged to had made provision for feeding themselves since the lights would undoubtedly affect cattle and vegetation.

The interview and questioning over, the man walked quietly out. But hardly had the door closed behind him when Buford touched a button on the desk. The Admiral waited impatiently for the verdict. He saw Buford's signal and spoke hastily into a phone. So although the man would walk away apparently free, four detectives were assigned to follow him and work on any leads that might develop from the trail.

Buford paced back and forth across the room while he recalled to the Admiral all that he had learned during the interview.

"So! A novel scheme to start civilization out on another footing. Who would think that they would go to such extremes?" The Admiral was amazed.

After examining the remaining suspects, from which nothing further resulted, Buford and the Admiral lunched at the office where they waited impatiently for word from the detectives trailing the subject. As the hours dragged slowly by they grew apprehensive. Why had they received no word? Eleven o'clock came and went but still no word came from the operatives.

"If we don't hear from them by midnight I think that we better send out a general search from police headquarters," the Admiral said. "I have an uneasy feeling about them. Since there are a number of people in this conspiracy it is not unreasonable to assume that they are having this building watched."

"I suppose that that is the only thing to do, but I suppose it is bad to let it become generally known that we have a clue. If he has thrown the men off his trail do you suppose that they would report?"

"Yes, at once. Of course, they may hesitate in the hope that they can again find him and thus avoid a blemish on their records. Isn't fear a strange thing?"

A down-town clock tolled out in solemn monotones the hour of midnight and the Admiral reached for the telephone.

"It's the police now," he murmured.

Ominous News

AS though anticipating his move the telephone bell broke the ominous quiet with startling abruptness.

"This is Admiral Midgard speaking," the head of the committee said.

He listened with growing tenseness to the other voice. Buford, striving to get some hint as to what the news might be, watched the man's face intently. As the Admiral listened he straightened suddenly into a rigid posture. His face paled and beads of perspiration broke out on his forehead. And Buford knew that there was bad news. Presently the officer appeared to interrupt the conversation for he almost shouted.

"Yes, yes! That's all that I want to know. I haven't time to listen to the rest of it."

He slammed down the receiver, spoke into the phone again and rushed for his coat and hat. Buford, without questioning, slid into his coat. The Admiral opened a case in which were kept a number of molecule disrupting guns. Arming himself and Buford, and edging off with several others in his arms, he led the way to the elevator. While they were ascending to the roof he explained to Buford.

"That was a call from an observatory on the other side of the river. The lights are starting again. We must try to find the infernal laboratory before it goes too far. Two dozen men are meeting us on the roof."

Buford was aghast! So they were doomed if they couldn't locate and destroy the laboratory in time. As they, together with the police, who had already reached the roof, tumbled into the large government ship which had been placed at the disposal of the committee, Buford strove to recall the exact location of the sawmill which he had discovered from the mind of his suspect. There was one mill that stood out in his mind as being the most likely location and he mentioned this to the Admiral. As they flew on at full speed he looked out of the con-

ning dome. The southern lights were growing in brilliance but they were still in the violet stage. The weird streamers were scintillating and wavering as though they were seeking a place to rest. They turned on the radio and listened to the reports from the news service. All power houses were being watched carefully and triple shifts of operators and dispatchers were on the alert for any indication of abnormal demand for power, but as yet nothing unusual was noticed other than the slight increase in load, due to the fact that people were turning on their home lights roused by the shouting and excitement.

When they reached the mill Buford had thought of, and the pilot settled the ship, he saw at once that this was not the location identical with the suspect's mental image of it.

Frantically Buford and the Admiral exchanged notes, when another mill similar to this one was suggested. They strapped themselves into the seats in the ship and upward it shot. It would be a matter of minutes before they could reach the next mill and the southern lights were already turning red—that color of new blood. They were almost despairing of ever finding the infernal laboratory in time to avert the tragedy.

The news service now reported that no power house had noticed any unusual load demand. Perhaps, it was announced, a little power might be drawn from each plant and load despatchers in the chief power plants of the world had ordered all power houses to reduce their load fifty percent. In this way the power available to the fiend would be possibly decreased.

This was a new obstacle in their path. For with all the power houses decreasing their load the source of power for their craft would be halved and they would be helpless in their pursuit of the criminal gang. While the pilot coaxed the last bit of speed out of the ship, the Admiral kept track of the time on his watch. Two of the minutes were gone and they were still some distance from their destination. Three minutes dragged into four while those in the ship were tense with apprehension. Four and a half minutes and they were still ten miles from the mill they sought to reach. The last half minute was an eternity of suspense but they were within five miles of the mill when the cabin lights were dimmed and the propeller tubes slowed down. Buford watching the southern lights saw them grow in intensity. He was now certain that the power for the diabolical scheme was coming entirely from a private source.

CHAPTER VI

The Sawmill

THE pilot switched on the emergency controls in the hope that their forward momentum might be sufficient to carry them to their destination. He carefully adjusted the energy change mechanism so that the potential energy was slowly transformed into power for the nullifier as they lost altitude. The kinetic energy of their forward motion was also sacrificed slowly to keep the nullifier in motion. They glided closer and closer to the ground. The southern lights were even now assuming the sinister black that spelled death to the terrified world. At last they were near the ground, skimming along rapidly and silently when close to the mill a tree-covered hill loomed above them. Just on the other side they could see the smoke-stacks of the mill projecting above the rise. They were belching smoke that blotted out the stars.

The passengers gasped as the hill rushed toward them. A crash seemed inevitable; but the pilot, with a quick motion, adjusted the energy transformer and the kinetic energy of their forward speed was suddenly changed into potential energy. With an overload of potential energy for their altitude the gravity became negative and the ship was pushed until the energy was balanced. So carefully had the pilot calculated that they could hear the treetops brush against the bottom of the hull as they slid over the top of the obstruction.

Their ground speed indicator showed that they were traveling only five miles an hour. As the hill was left behind they saw the mill, like some grotesque monster sprawled out over the valley in the weird light. Here and there lights gleamed dully, showing that steam was up and that a local generator was in operation. But the southern lights were now almost completely black. Soon the Northern Lights would start; and then it was but a matter of minutes before the world would be a dark, silent morgue.

The pilot found a place to land near the powerhouse of the mill and transformed all of the kinetic energy of their forward motion into potential energy. The ship bounced upward, much as if it were an old style ship that had been zoomed to a stall, where it remained stationary except for the slight energy dissipation, until the pilot permitted the potential energy to escape through the release mechanism. The craft settled gently to the ground where it lay inert, now that it had no power, and as useless as any twenty tons of scrap iron and steel.

Quickly they crawled out of the cabin and ran to the boiler room. They burst into the place and stopped in amazement. There were three firemen dressed like grotesque divers, but with shining metallic clothes. One of them reached for a disruptor gun that lay upon a chair; but the police were too quick for him and had the queer trio covered. One glance over the droning plant indicated that the fires were burning briskly and that steam was up. Buford heard the monotonous clank of the fuel conveyer chain and knew that they were firing heavily. While the police advanced upon the firemen the Admiral gave the word to strip the masks from the men. All three proved to be strangers. For two minutes they were subjected to examination.

Now that they were stripped of their protection they were beside themselves with fear. Eventually the Admiral made them understand that he wanted access to the laboratory, and one of the strangers conducted him up a flight of iron stairs to the tops of the boilers. On the way up Buford noticed a fourteen-inch steam line leading from the header into which all the boilers fed and disappearing into the ground. There was no valve in the line. A fireman on being questioned explained that they had anticipated trouble and left out the valve that no one might shut off the steam at a critical moment. The Admiral ordered the men below to pull the fires and cool the boilers while he and Buford went outside to see what the lights were doing. To their horror they found the Northern Lights almost at its peak while the southern lights were a curtain of sinister, choking black.

There was no time to cool or bank the boilers, nor even to shut off the valves between each boiler and the steam header. "We must smash the boiler," the Admiral shouted. Buford nodded, understanding. Rushing back into the building to get out all its occupants, they retired two hundred yards from the main. The men trained their disruptor guns on the house. Finally there was a hiss and a blinding flash of light as the disruptors ate through the boiler steel and then came a tremendous explosion that knocked the men from their feet. The southern lights had now progressed so far that Buford realized that only minutes were necessary before he would lose control of his faculties.

Shaking with the reaction of the explosion the men gathered together. The Admiral ordered them to spread out along the base of the hill to keep a sharp lookout for any attempt on the part of the conspirators to escape. The force of the explosion must have made itself felt even underground and doubtless the conspirators would be coming to the surface to investigate. He and Buford took the station near the northeast corner of the lumber yard where it came close to the hill. For a few minutes they scanned the base of the hill, from the point where they knew that the pilot was stationed, to the other side, where one of the guards was hiding. Presently a man crawled out of a thicket in a little gully and started toward the power house of the mill.

"Halt!" Buford called out sharply. "I have you covered."

The Fiend Revealed

THE man froze in his tracks and held his hands high in the air. The guard stationed to the west came running upon hearing Buford's challenge and in a moment they had the man disarmed and his arms handcuffed around a small tree. He proved to be a stranger and a very terrified one. Buford and the guard watched the spot where they were sure that the entrance to the laboratory must be and soon another stranger emerged. He too was quickly cuffed to a tree. Certain now of the approximate location of the entrance the two now went to investigate. Word of the discovery had traveled around the cordon and the others of the group came running up. Leaving the rest to guard the end of the gully and the prisoners, Buford and the Admiral, according to a change of plans, went up the gully and searched for some hidden door. At last they saw a dim square of light and found a trapdoor flung open, revealing a dimly lighted shaft down the side of which was bolted a short ladder. After examining the shaft the two, with their disruptor guns in readiness, followed by a dozen of the police, quietly descended the ladder and found themselves in a little ante-room, a sort of dressing room where hung a number of the lead suits and helmets. They assured themselves that there was no one in the ante-chamber and then went to the door leading out of the west end of the little room. Cautiously they opened it far enough to peer through. There was the west end of what appeared to be a large room. It had evidently been excavated with a molecule disruptor, for the walls glittered with crystals formed when the released electrons again built into new atoms and molecules after the action of the disruptor. In it was a maze of electrical apparatus and in the end of the room was the huge turbo-generator for which the General Electric Company was searching. The wall at one side of the machine was composed of loose material and Buford surmised that a hole had been cut to admit the generator and then had been closed by blasting down a section of the hillside. Except for a switchboard along one wall and the gauge board on the turbine the room was dimly lighted. Over these two boards, however, were bright lights. From several places on the switchboard gleamed red and blue pilot lights. The room seemed to extend to the other side of the ante-chamber. In other words, the ante-chamber was in the center of the south wall of a very large room.

Buford pushed the door open a little more but could see no one. He looked through the crack along the hinges. No one was hiding behind the door. With their guns in readiness they pushed the door all the way open, and, carefully looking around to avoid surprise, they advanced into the large room, followed by the police. But there was no one in sight. Buford wondered vaguely how the place was lighted, now that they had cut off the steam from the generator. He found out later that an emergency storage battery supplied light and control for the switchboard. After looking around they crept to the corner of the ante-room partition that they might look down to the other end of the mysterious laboratory.

They peered cautiously around the wall and paused in wonder. At first they saw a maze of wire, huge air core transformers, and rows of great vacuum tubes. They might have been radio tubes, towering high into the air, were it not for the complication of elements within. Around the base of each tube was a solenoid of copper wire that gleamed dully in the dim light.

They were so amazed at the array of apparatus that they were for a moment confused, but as Buford identified the various elements of the room, they marvelled at the magnitude of the place and at the monster of science that it housed. The cavern was large enough to contain an old-fashioned baseball diamond, bleachers and all. One of the huge vacuum tubes must have been sixty feet high and about thirty in diameter. There were three rows of them, totalling about a hundred in all. Suddenly as they moved silently about, they discovered half way down the vast cavern a man sitting before what appeared to be a desk and remote control switchboard. He was dressed in the same glistening metallic suit as the others except that for the moment there was no mask over his face. He was telephoning. He dialed a number and waited, but there appeared to be no response, for he slammed down the receiver impatiently and busied himself with the control board. Buford thought that there was something vaguely familiar about him, but he was too far away to see clearly enough to recognize him.

Making sure that there was no one else present, the group advanced carefully with their guns in readiness. Walking between rows of tubes that their quarry might not see them, Buford and the Admiral advanced to a point near the center of this section of the room and in front of the control board. They peered out and saw that the man was bending over his desk, evidently studying some drawings. His visor shaded his face and also hid them from his view. It seemed to Buford that there was something sinister and gruesome in the very atmosphere—something indefinably cutting and chilling like the death row in the penitentiary. Yet here was something more. He felt as if he were looking upon his Satanic Majesty who from his throne was about to order the death of every living thing upon the earth.

So intent was the man that he did not notice the stealthy advance of Buford and the officer. Buford thought that he must surely hear the heavy thumping of his heart. They stood beside the control table with their guns covering the fiend, and waited silently. The young man watched him intently. Presently the man began to fidget and exhibit discomfort, and Buford knew that he was becoming aware of their presence. Suddenly the man looked up, started violently and turned swiftly.

Buford was so startled and amazed at sight of the man's face that he almost dropped his gun. Beside him the Admiral was rigid with consternation. They were staring open-mouthed upon none other than Ferdinand DuMar.

The Danger Over

FOR the instant that they stood rooted to the floor it seemed to Buford that a million thoughts stumbled over each other in their race through his mind. "DuMar, the fiend. Impossible. Yet, what else could this mean. Good God! What about Helen! What should they do with this man?" But suddenly the thought of the danger to the world became uppermost. Motioning the man away, the whole panel was instantly demolished by turning ten disruptors on it. On the other side of the cavern, carefully guarded, was DuMar sitting dejectedly in his chair.

The demolishing of the apparatus had hardly been completed when one of the police who had been guarding the entrance came running down to state that the lights in the south had disappeared.

It was not until the next morning that the Admiral gave to the news service a lengthy report of all that had happened, dwelling at length upon the wonders of Buford's invention and the part it played in the saving of the world against a plot to destroy it. The people greeted the news with a hysterical joy after the tension of the past month.

Now that the danger was over attention of the public was turned to DuMar who was being held secretly incommunicado. The great interest was in the man's motive and in seeing that he met a prompt punishment. But they arrived at no satisfactory conclusions, nor could anyone discover where DuMar had been hidden.

Little had Buford dreamed that his invention would lead to so trying a situation. He was glad that he had been instrumental in saving the world from the sinister, painless destruction, but he was now in a position that made him unhappy and miserable. He almost wished that he had not interfered, rather than to have brought about this end. And to make him supremely miserable, Helen told him that she was sure that her father was not guilty and accused him of every duplicity and every shameful ambition. She concluded her remarks with the flat statement that she would never see him again —and forthwith burst into tears.

The two weeks that followed kept Buford busy looking over contracts offered by manufacturers, interviewing news reporters and scientists, and continually wishing that he were dead. His success was like ashes in his mouth. And while Buford was thus engaged, Ferdinand DuMar was tried and condemned to death. He confessed during the trial to his being the inventor and prime mover of the whole project but steadfastly refused to give any explanation.

It was after the confession was published that Helen came to Buford and he was overjoyed when she asked his forgiveness and begged him to do something toward the pardon of her father. He pondered this for a time and suddenly recalled his machine. Leaving her without explanation he ran out to his ship and was soon on his way to Admiral Midgard. He explained his purpose. There followed a conference with the Governor and the result was that they were given permission to apply Buford's apparatus to DuMar.

He found himself looking into a world of pain and suffering. To the billions of people of the earth, life was simply an attempt to escape from the

spectre of mental and physical suffering. Looking upon this with DuMar's eyes, he became filled with a great overwhelming pity—a pity that mounted to such heights that it became a continual obsession. The guiding thought had been—how can I free the world from pain?

The End of DuMar

LOOKING into DuMar's memory, Buford saw how this had been done. He saw DuMar working with feverish energy through long years to perfect means to permit of painless and bloodless operations. He endowed and built hospitals so that the masses of suffering poor—poverty-stricken and helpless—might get the best of attention. Buford saw now that it was DuMar's utter inability to see the face of a suffering man that kept him away from his completed hospitals.

Gradually as DuMar realized the utter futility of all he could do to stem the growing tide of world-wide suffering, he became filled with the idea of giving the world eternal release from pain. Since suffering it seemed was inevitably man's lot, there was once answer; exterminate the race.

DuMar pondered this idea for a long time. He was loath to do such a thing; but then he could not face the alternative of eternal pain. Buford saw how a veritable mania seized DuMar until his mind was no longer sane. He brooded for days on end seeking for a way out; and when none was found he decided that extermination was necessary.

He realized, though, that the death of the race must be a painless one. But how to do it?

It was as a result of his studies in the phenomena of light, particularly of the Aurora Borealis, that he found his answer. He saw with deep insight the connection between light and life. He had discovered that in the energy called light there existed what he called *vitaloris*. It was not material—yet in the strict sense it was not physical energy. It was an *emanation* of whose nature he was not certain, but it had a remarkable effect on the life processes. Experiments performed with rabbits and guinea pigs has shown that by the filtering of *vitaloris* from light the animals died. Here at last was something to work on.

Years of research followed—experimentation with various means of devitalizing light in large quantities. And one day the answer came. He found that when he passed a beam of light through a prism and then applied an alternating current that he could place the light in such a state in which it was devitalized. He then turned upon his animals a beam of this so-called "negative light," and the animals died as before. Here then was his solution. What he had to do was to produce a great quantity of light energy, a great source of light comparable to the Aurora Borealis, expose the world to it. Then when he devitalized it all life, even that of plants would become extinct.

With this in mind, a hurried trip to South America followed where in uninhabited districts DuMar established his light generators which should produce in the southern sky the counterpart of the Aurora. At the appropriate time, as the light would be filtered from the violet to the red end of the spectrum it would be gradually devitalized until negative light was produced.

Then came the problem of how to operate this huge scheme. But to DuMar's fertile mind, concentrated with all the intensity of a madman, it was easily solved. He set up in his South American base a set of apparatus which should be actuated by very short wave radio signals. Then in the deserted sawmill land he stole power from the power plants to shoot the signals by directional beams to the South American base.

Everything passed off as planned. He knew it was necessary to expose the invention to the world before he was ready for its extinction by making several demonstrations to see how it worked on a large scale and correct any errors. He had even anticipated the discovery of the purloining of power and had planned in advance the purchase of a huge generator to supply the local power and actuate the apparatus at the South American plant.

With amazement and horror Buford saw that on the very evening when DuMar had been captured, he was really ready for the world's extermination. His confederates, deluded into the belief that DuMar was going to start another civilization in which only they would be the survivors, had joined with him in his plan. But he had fooled them; for the suits with which he had provided them as protection against the negative light were futile to withstand the devastating effects of the negative light, once he released the full power of his apparatus. They too would go the way of all flesh; and even he would at last fall lifeless from his chair.

Buford desired to determine one thing more. What was this man's attitude now that his plan had failed and he faced execution at the hands of a rightly indignant world?

And what Buford saw made him turn away in sadness—a sadness that no amount of indignation could overcome. He saw in DuMar a man whose soul was sick and who desired death. It was as if he had turned on himself the full force of the "negative light" and his life force had been drained.

And so it came about as DuMar desired. Four days before the execution, the body yielded to the will. His vitality exhausted, the life force gone, he sank into a coma from which he never recovered.

It was for Buford to console the grief-stricken Helen. Gently he told her of her father's great idealism; that however mistaken he had been he was actuated by a desire to help the world. He was sure that when the indignation of the present day had died down and a new generation came to look upon DuMar and his work that he would stand out as one of the world's greatest, although one of its most misunderstood men.

And Helen resting her head on Buford's shoulder understood and was content.

THE END.

The Land of the Bipos

BY FRANCIS FLAGG

(Illustration by Paul)

Without hesitation Red took the place of the Bipo. Then a picture filled the screen. The Bipos followed the picture, enthralled, their single glass lenses gleaming. Step by step, it developed his story.

THE LAND OF THE BIPOS

I KNOW that few will believe this story. Even to me, after undergoing the experiences herein narrated, it seems like the most fantastic fiction. And no wonder; for, with the exception of myself and Red Saunders, no earthly being has ever gazed on the country from which we have recently returned.

It happened without any premeditation on our part of such a journey. To begin with, Sanborn kept the drug store which stood on the corner of Fourth and Main Streets in Pueblo, Colorado. Sanborn himself was almost a recluse; a queer, eccentric fellow of about fifty, with cavernous clean-shaven cheeks and piercing blue eyes. His store did a prosperous business; enough to let him employ a half dozen clerks and to devote himself to some mysterious activity in the heavily-shuttered, locked rooms above his place of business.

FRANCIS FLAGG

Somehow, the rumor started, that he kept all his money in those rooms. People said that he was a miser; that he distrusted banks; that he was turning lead into gold. In fact they said a great many things about Sanborn over a period of years; coloring their imaginations with what they did not know. His clerks, five middle-aged men, and one young woman, neither knew nor professed to know anything about him, unrelated to their jobs. That no one, save Sanborn himself, ever entered his mysterious sanctum; that he kept the door to it securely locked and barred; that at stated intervals, over a period of several years, odd pieces of machinery and what appeared to be massive chunks of lead, were delivered to him at the store — was common knowledge. Wild tales of stores of hidden wealth in those upstairs rooms reached Denver, and trickled into the basement of a certain pawnshop on Larimer Street, which had better remain nameless here. Let me admit candidly that this basement was then the headquarters of a somewhat notorious gang of which I had become a member. I dislike making this confession, but I must do so, in order that you may understand how it was that I came to Pueblo and made unwillingly the acquaintance of Sanborn.

I drove to Pueblo with Red Saunders, in his Buick roadster. Louis Levine, another member of the gang, was coming by train. Red and I had met shortly after my expulsion from a mid-western college. I won't mention why I was expelled. I'm not proud of the reason, and to describe the incident may identify me in the minds of those to whom I have long been dead.

Red was an old hand at the game of crime, though as young as myself in years. It was through him that I had met the outfit in Denver. Once, in a burst of confidence, he told me that his father was a well-to-do merchant in Boston, and that he had run away from a prep school when sixteen, taking to the road and living by his wits.

"That's the 'crib'," he said, nodding his head casually towards the store: "Give it a good look-over, kid."

"It doesn't seem a tough lay-out," I returned, as we passed it and circled the block.

"You never can tell. Here's the dope Slim got last week, and a plan of the building and neighborhood. Post yourself thoroughly on the get-away," he said: "Louie will be the lookout, and have the car parked at the place on Santa Fe."

While we were eating our dinners in the American Cafeteria, and later sitting through an Oliver Curwood picture—"Nomads of the North," I believe it was—in the Palm Theatre, neither he nor I dreamed that we were pulling our last job.

But enough! No two crooks ever went more blithely to their work than did we, an hour before midnight.

At eleven p. m. the drug store closed. The

MANY scientists who have made a careful study of the history of the earth and the evolution of various forms of life have come to the conclusion that it may have been a happy accident that gave man his start up the evolutionary scale.

The discovery of a thing such as fire may have been all that he needed to give him dominance over other forms of life and provide him with the security necessary to develop his surroundings and his intellect.

We human beings who look upon other forms of life on our planet as being inevitably inferior to us will get quite a shock from Mr. Flagg's story. He poses a situation in which conditions are exactly reversed, where the form of life known as man is not supreme, but, in fact, occupies the same position as cattle do on our own earth.

Evolution has always depended first on adaptation to environment, and second on the domination of that environment. Once man got his start, it was his remarkable ability to adapt himself to environment that gave him dominance over other forms of life.

A thing so commonplace to us as the development of his hands so that he could hold, and later mould things was of supreme importance. But what we must remember is that there was no inevitability about man's development. If another form of life had developed as quickly as man, there would have then occured a terrific race for supremacy, and if that other form of life had developed faster than man, there is little doubt but that man would either have vanished from the face of the earth in that death struggle, or he would have been relegated to a sadly inferior position. You will be thrilled by Mr. Flagg's development of this theme.

clerks went home, and Louis had shadowed Sanborn himself to his hotel nearby. Squatting on our haunches in the small, bricked-in yard at the rear of the shop, we found it the work of but ten minutes to saw a square section out of the heavy wooden door which gave admittance to the building.

"You see," said Red, coolly instructing me as we went ahead with the task, "we don't want to fool with locks and bolts—not on this job. The doors and windows may be wired. Open 'em, and an alarm goes off. This way, there isn't much danger."

For a moment he played the pencil-like beam of his electric torch through the opening the saw had made.

"All right," he said at last: "In we go!"

The Laboratory

MY heart beat nervously; I was a novice at housebreaking. But my companion, whose eyes had taken in everything during the brief illumination of the torch, stepped slowly but surely ahead in the darkness and drew down the shade over the only window. Returning to the door, he wedged into place its sawn-out section; yet not so securely but that a quick push could easily remove it. Then, and not till then, did the beam of his torch sweep the room freely. It was a storeroom, evidently for drug supplies and for compounding prescriptions; from it a broad staircase led to the regions above. Very softly, in our felt-soled shoes, we mounted those steps.

At the top was a small landing, and another heavy wooden door, locked, which we treated as we had done the one below. The windows on the second floor we knew to be heavily shuttered. Therefore, Red found the switch and turned on the lights without much apprehension.

The room in which we found ourselves appeared to be a well-equipped laboratory. We saw rows of white metal tables on which lay various devices, mostly strange to us, retorts, and test tubes. A small smelting furnace stood in one corner, and gave color to the rumor of manufactured gold. A quick search, however, revealed nothing of more value here; so we passed through an arched entrance into a larger room occupying the whole front of the second floor. We stared with lively curiosity. Contrasting with the neatness of the laboratory, everything here was apparently in a state of disorder. One side of the room was taken up by a long table or bench on which were scattered a profusion of papers, blue-prints, tools, and machinery. An electric dynamo stood at one side of the entrance, and an odd-looking machine on the other. But the object that drew both our eyes was the huge elongated glass contrivance with a globe-like center which stood on crystal-like spidery legs in the center of the room.

"What in the devil can it be?" ejaculated Red.

Then he shrugged his shoulders.

"But that isn't what we came to find out."

I pointed to the front of the room, beyond the glass cylinder.

"There are heavy boxes over there," I said: "Perhaps—"

Both of us went forward at the same time, neither of us heeding a large metal plate which was lying on the floor. As our feet came down simultaneously upon it there was a blinding flash, a rending shock, a second of twisting agony. I thought I heard Red screaming—perhaps it was myself I heard—and darkness came like a swift eclipse and blotted out consciousness!

Trapped!

WHETHER we lay dead to the world one minute or several hours, it was impossible to know. The return of our senses found us awkwardly cramped inside a small space or chamber, the sides of which were partially transparent. Imagine our sensations when we realized that the thing in which we were imprisoned was the elongated glass globe, standing on those spidery legs! We could neither stand straight, lie, nor sit at ease, for the curving glass surface around, above and beneath us. Quietly observing us was the chemist, Sanborn; he was seated on a high stool, and the queer machine we had noticed at one side of the door was now in front of him. Sanborn spoke, and we heard his voice. It was clear but faint, as though it came from a great distance.

"It is useless to struggle", he said: "Your blows cannot break the glass."

We stared at him fearfully. The thick glass surrounding us did queer tricks with his face. "Red," I whispered, "Red!"

"All right, kid, don't lose your nerve."

Sanborn coughed drily: "Just when I needed someone for experimental purposes, you two were obliging enough to drop in."

I looked at him, fascinated; his piercing blue eyes regarded us without emotion.

"Both of you are criminals. You came here to rob me. God knows how many crimes you have committed; you may even have murdered! In any case, if I were to turn you over to the police, you would undoubtedly be sent up for long terms of years. But I will do better by you than that—" (was he, we though hopefully, going to let us go free?)—"I will allow you to pay your debts to society by being of service to science."

Our hearts felt like lead. "What do you mean?" asked Red, hoarsely.

Sanborn returned slowly: "Well, I am a scientific investigator. That tube in which you are imprisoned is one of my inventions. I call it a cathode-ray tube for convenience, but it is that and something else besides. Perhaps you may have observed violet-ray lamps. Well, the same principle is manifested in the tips of these electrodes; but with a difference—" he tapped the machine in front of him with a heavy finger— "a difference of— But there! It is useless to explain further. Neither

of you could understand the technical nature of the language I would have to use. Suffice it to say, that new rays are released, utilized, in that tube."

He was lecturing to us as unconcernedly as a professor might to a class of students. We listened to him as rats in a trap might listen to the purrings of a cat.

"I have used guinea pigs," he said, "and rabbits, and by electrical means changed their plane of existence. Sometimes I have been able to bring them back from wherever they have gone. Sometimes—but not always. However, animals cannot talk; they cannot describe their experiences. That is why," he said unctuously, "I need human beings with whom to experiment."

"Human beings with whom to experiment"! The phrase sent a shiver of fear through my body. "Good God!" cried Red, "would you murder us, man?"

"Murder, murder?" said Sanborn coolly: "Really, I hardly think you could call it that. It is true that man isn't a guinea pig or a rabbit, and that one can never guarantee the effects of anything. You may, for all I know, be annihilated; that is, if anything goes wrong. And things are so apt to go wrong!

"But consider," he said argumentatively, "if you were to continue going on in the course you are pursuing, both of you would inevitably end by being hanged or electrocuted. Is that, I ask you, a better fate? Besides, I don't believe you understand what purpose is being served through an experiment on yourselves.

"Have you ever realized the stupendousness of Einstein's assertion that the universe is curved? No, you don't; and very few men do. But if it is, and light rays are curved by it, in time they will return on themselves, modified by all the forces of the universe that may affect them in their journey. Consider that we live but threescore years and ten —though few of us do—how brief a span in which to observe anything! Why, this earth and all its inhabitants—yes, and the universe of which they are a part, may be blotted out and destroyed ere a light ray which passed by before our planet was born, returns again!"

I clawed at Red's arm with trembling fingers.

"And not only that," Sanborn went on slowly, "but when that light ray, and all the other light rays which have gone by since the world began, travel their former paths once more, it is quite within the realm of possibility that in a higher, more coherent manner, all that has been may again be."

"My God," I cried, "the man's crazy!"

"No," said Sanborn mildly, "I'm quite sane, I assure you. I have explained, or attempted to explain, an interesting speculation connected with the theory of the curvature of space. It was my thought that, if I could awake your minds to the marvelousness of all this, elicit from you some enthusiasm for scientific research along such lines, you might not object so strenuously to having your bodies reduced."

"Bodies reduced!"

"Please don't interrupt me," he said severely: "Object, I say, to having your bodies reduced to free electricity."

Although we learned later that this was not what he intended doing—that he wished merely to transport our bodies to a new plane of existence—we could not know at the time that he was merely trying to frighten us.

"But we do object!" cried Red fervently: "We object to being guinea pigs for your experiments! We demand that you call in the police, turn us over to the authorities—"

"Tut, tut," said Sanborn: "Don't be absurd. It is for me to decide what disposal I shall make of you. If I had shot you to death when you were breaking in, I would have been within my rights as a citizen defending his property. As it is, I choose to use you in my work. Really, I don't see that you have any choice in the matter. Reduced to electronic units, the velocity of which should not exceed a hundred and eighty-six thousand miles a second, the speed of light, you will travel into the unknown, and it is my theory—"

He never finished the sentence. I saw Red's hand come away from his armpit, and an automatic was in its clutch. With the blunt muzzle pointed at Sanborn, and but two inches from the glass, he pulled the trigger. Now, even among the gunmen of our gang, Red was considered a wonderful shot; but all the marksmanship in the world would have availed us nothing at that moment. The bullet struck the glass wall, which glowed red hot for an instant, and dropped finally, a flattened piece of lead, on the bottom of the tube.

Sanborn looked at us unperturbed: "As you perceive, the glass is impervious to bullets. It is of great tensile strength; a high-powered missile would have been as useless."

Then the fact that we had tried to kill him seemed to dawn on his consciousness for the first time, and his countenance darkened:

"You would kill me! That is nothing. In return I use you, so—"

His hand went to a switch set on the face of a graduated dial affixed to the machine in front of him; instinctively we knew what it was. "When I turn this lever—" he said.

"No, no!" I screamed; but with steady motion his fingers moved it around.

Instantly a white glow leaped through the whole of the glass chamber, hot and blinding. I felt it flowing through my limbs, surging in my head, rioting in my veins. I clawed at the glass and screamed. Sanborn's face was a gargoyle, a monstrous thing leering at me through the growing cloudiness in the globe. Every particle of my flesh was vibrating, dancing, faster, faster, to the rhythm of thunderous music. I tried to shout, to make one final plea to the chemist to turn off his infernal

machine; but, even as I made the effort, my brain soared, expanded, burst like a giant skyrocket into myriad glorious colors which illuminated, for one breathless moment, an ocean of blackness—and then went out.

CHAPTER II

Those Birds!

As far as the eye could see, there was nothing but a barren plain. It ran in long bare surges to meet the descending sky. The sun, a green molten mass of radiant energy, blazed in the heavens, and the sunlight glinted on a huge round body of burnished metal which hung motionless in the air, perhaps fifty feet above our heads. We staggered to our feet and gazed wildly around us. "My God!" I gasped, "what place is this? Where are we?"

Red brushed the tangled hair from his eyes: "I don't know. Look! What is that?"

With bulging eyes we stared at the globe above us. Nothing that was visible to our sight supported it; no wings, no whirring propellers. Even as we gazed in amazement, what appeared to be a panel in the side of the metal mass slid back and, through the aperture thus created, there rolled a platform on which perched creatures resembling giant birds, three feet or more in height.

Their wings were rudimentary affairs, in some cases barely discernible, and their short taloned feet gave them the erect posture of penguins. From underneath the wings extended two limbs, with three claws on each limb set in opposition to a fourth and shorter one. Over their heads, reaching almost to their blunt beaks, were hoods from which projected a single lens. Even as we glared fearfully upwards, one of the creatures swooped.

"Run!" shouted Red, but his warning came too late; and, even if it hadn't, there was no refuge we could run to. We stumbled and fell; and, as we fell, over us hovered the giant bird. Dangling at the end of its taloned feet, we were lifted, struggling, into the air, finally to be deposited on the platform projecting from the side of the burnished globe. Dazed, and shivering with fear, we crouched in the semi-circle made by those unbelievable creatures, and submitted to a solemn inspection through their glass lenses. One of them ran its "hands" over our clothing in what appeared to be surprise; but no attempt was made to search us. Otherwise, our automatics (Red had returned his to his holster after the abortive attempt to shoot the chemist) would have been discovered, and undoubtedly confiscated.

The creatures in front of us opened and shut their beaks for a long time. We came to the conclusion that they were talking to each other; yet we could hear no sound. Finally they desisted and then, to our despair, we were dragged into the interior of the metal globe. The darkness, after the weird but bright light of the outdoors, was impenetrable to our eyes. We were pushed into what was evidently a small room; a door clanged hollowly, and we were left alone.

"Red," I asked him after a while, "what has happened to us?"

"I don't know," he said: "I'm not sure. But you heard what that crazy druggist told us. He was going to reduce our bodies to electrons—whatever those are—and let them travel somewhere at the rate of a hundred and eighty-six thousand miles a second. Well, he did—and we're arrived."

"But where?"

"How should I know! On another world, perhaps; it can't be on the earth. Those birds—"

"My God, Red," I said, trembling, "they're intelligent."

"Yes," he said, "yes. I read a story once—in one of those science-fiction magazines it was—about a trip to another world. The inhabitants of it were like plants. And H. G. Wells in *The War of the Worlds* made his Martians something like octopuses. Bunk, I thought it then; but now!"

After a while I said slowly: "Ever hear of a Fourth Dimension? Perhaps that's where we are, on another plane." The very thought made the goose-flesh rise on my skin.

"Well," said Red lugubriously: "We're all right physically; we've got that to be thankful for."

"But for how long?" I thought, miserably.

Time dragged by. We huddled together for comfort. Fortunately the air of our prison cell was warm. There was nothing to do but sit and think, and talk in broken sentences. Finally, worn out, we must have fallen asleep.

Our captors roused us; and we were taken from our cell, out of the globe and into the open. The sphere was on solid ground; there were hundreds of similar globes arranged in rows. In front of us was a cluster of large, strange-looking buildings, mostly of one story, occupying several acres of land. Into one of them we were pushed.

And now we were shocked out of the lethargy that had fallen on us; for the attendants who hurried forward to greet our captors were monstrous creatures, half bird, half lizard! Red, they were, of a fair size and build; their scaly bodies resting on four web-toed feet, but with two claw-like hands projecting from just below the long necks. They reminded us strangely of swans; while their heads were like those of plucked vultures. Never, even in nightmares, had things more hideous been seen. It was impossible to look at them without feeling fear and loathing. The birdlike creatures communicated with these horrors by a rapid play of their "fingers", in a sign-language fashion. The near-reptiles replied in like manner, their long necks drooping, their heads submissively resting on the floor at the feet of their masters, the birds. And from this we deduced that the lizard-vultures were servants or slaves. The bird-masters went away,

and our new guards led us down a long corridor which ran the middle of the building. Stall-like compartments opened off this corridor on either side, and in these stalls we could see. . . .

The Human Cattle

SUDDENLY Red seized me by the arm. "My God, Pete," he exclaimed, "there are people in there—men and women!"

It was true. Human beings were in those stalls, standing up, lying down; human beings like ourselves, though their unclad figures were darker, bronze-colored. We stared at them, petrified. And even as we stared, we saw metal collars on their necks, and burnished links which ran from the collars to staples in the walls. It didn't require Red's horrified whisper to make me aware of an unnerving fact.

They were chained in their places!

"Who are you?" we shouted: "What country is this?"

I could see some of the men and women straining at their chains, waving their hands, calling out to us in a language we could not understand; but the majority only stared at us apathetically as our guards inexorably urged us ahead. There was nothing to do but comply.

The end of the corridor gave access to a large chamber, bleak and gloomy, evidently some sort of a store room or granary. Not unkindly, the lizard-birds (there were two of them) gave us what appeared to be a species of wheaten loaf to eat, and water to drink. We received the fare gladly. While one of them watched us, the other went into an adjoining room, whence echoed some clanging blows, of metal on metal. Red said to me, without any show of secrecy: "I don't like this, Pete. Something tells me those creatures are getting ready to chain us up."

"We musn't let them do that," I said quickly, shuddering at the thought of the other men and women with gyves around their necks.

"No," he agreed; "but if we don't wish that to happen we'd better act at once while only one of them is here. See that door over there? It goes —God knows where! But outdoors, I hope. Both together, now! Hit that thing over the head—and run!"

It was time. The blows had ceased in the other room. At any moment the absent guard might appear, bearing chains. Seizing, each of us, a heavy rod of metal from the table, we sprang at the monster standing carelessly to one side, and fetched it vicious blows over its head and its instinctively-upthrown claws. Taken utterly by surprise, it reeled back, dazed, half-stunned. Before it could regain its shaken senses, we reached the door we had selected, just as the returning guard appeared on the scene.

To our disappointment, the door did not lead to the open; instead, it gave access to a low, winding, passage, almost dark. Behind us could be heard the noise of pursuit. Suddenly the passage branched; without slackening speed we took the road to the right. Our pursuers must have continued on down the main passage, because the noise of their clattering progress quickly died down.

We leaned against the wall, panting. "Now we must be careful," said Red, "and not blunder into a trap."

We went ahead cautiously and came to another door. It was closed. Anxiously we pondered; should we open it or not? Yet we had no chance. Our pursuers would undoubtedly realize their mistake in time and come back and search in this direction. With our automatics in our hands we pushed at the metal door. It opened with a creaking that brought our hearts into our throats. At sight of what lay beyond the door, both of us fell flat on our stomachs and hugged the cold stone. We were at the head of a short incline which led to a large open space below; a space enclosed on three sides by buildings with runways leading into them, and at the far end by a high wall. This space or corral, was thronged with a crowd of naked human beings, mainly women with children at their sides. What we noticed particularly was the apathetic manner in which they squatted down or wandered stupidly about. A number of lizard-birds waddled around among them, here and there stopping to examine a woman or a child, prodding them in the ribs or flanks, handling them like—

"Cattle!" whispered Red. "Good God! They treat them like cattle."

The inference was plain. As we stared, that happened which filled us with loathing and horror. Out from the open door of a large runway slid a long metal bar; one end of which was hidden in the gloom from which it emerged, the other projecting into the open with a hook dangling from it. Seizing hold of a woman, the lizard-birds picked her up and suspended her from the sharp hook, much as a butcher might suspend a hare, or a side of beef. The unfortunate woman screamed terribly, horribly; but, stampeding to the further end of the open space, the rest of the human beings did nothing to help her. In fact, as soon as the metal rod had been withdrawn back through the runway and the woman had disappeared, they seemed to forget all about the matter. The lizard-birds went on with their ruthless work of hanging the wretches, one by one, to that hook, which reappeared and withdrew until the last of them was disposed of. Sickened by the sight, we cowered in our doorway. Many a time I was tempted to fire my levelled automatic, but Red hissed:

"We can't help the poor devils. To interfere would mean our finish as well as theirs. Save your bullets, Pete; we'll need them later."

CHAPTER III

A Rescue

THEIR work accomplished, the hideous monsters went away, some through a gateway in the further wall. But we dared not leave our place of concealment until the darkness, already beginning to fall, had deepened. As we huddled together, the true enormity of our situation overcame us. We were in an unknown land, a new plane of existence, whatever one cared to term it, surrounded by strange, dominant, ferocious beasts. We were fugitives from them and hunted. . . . Is it to be doubted that terror gripped us, that we wondered fearfully what fate the future held in store for us? I gripped Red's arm convulsively.

"We must get away from here," I exclaimed feverishly.

"Of course," he replied more calmly, "but where to?"

I stared at him aghast. What if the bird-masters controlled their own world as completely as man dominates the earth? What if human beings, such as ourselves, were numbered with the beasts, wild and domestic? Oh, it was impossible, incredible! Man, wherever he existed, must be, the dominant species, master of all he surveyed. And yet—

The deep blackness of night came at last. One phenomenon we noticed: there were no stars overhead. Three moons, in size like golden grapefruit, came up together over the far wall of the enclosure, and swiftly ascended the sky, giving out an almost uncanny light. It was strange, like nothing we had seen before. I think that fact oppressed us as much as anything else. Then they disappeared and blackness—beginning with the very space above our heads—blackness, like a palpable, an impenetrable wall, fell over us.

Under cover of that darkness we stole from our hiding place. Runway after runway we peered into, but all gave access to buildings, which we dared not enter. Finally, in the far wall over which the moons had climbed and for which we groped, we found the gateway, a door opening into what had appeared to be open country. To the right of us we could see now glimmering lights from those immense globes, the dark bulk of buildings vaguely outlined behind them. Turning from them to the left, we fled swiftly into the night, seeking to put distance behind us and the place of our captivity.

At first the country was rough, but open; then it became wooded. The ground was tangled with long growths; brambles tore at our faces, our clothes. Soft, winged things beat against our shrinking flesh. Insects, glowing like fireflies, flashed here and there. After what seemed hours of toilsome progress, Red ordered a halt.

"We may be traveling in a circle," he said: "It's too dark to see. Let's save our strength until daylight."

Exhausted, we sank on the ground, resting as well as we could; sleeping by fits and starts. Toward morning we were roused by the sight of a dozen glimmering globes floating silently by, high overhead. We watched them with straining eyes until they disappeared into the immensity of night. On what strange mission were they bound? Our fears on seeing them became so great we could sleep no more. Dawn came swiftly and found us in the midst of a dense forest. Though both of us were unbelievably stiff and sore, Red climbed a tree and tried to survey our surroundings.

"There is nothing to see," he said, "nothing but woods."

Slaking our thirst from a stream of running water, which ran white and tasted as if it were impregnated with soda, we chose a direction that kept the green morning sun over our right shoulders and plunged ahead.

About noon the forest ended. We stood on the edge of a rolling prairie of waving grass and small shrubbery. But the grass, odd and very green, was little more than two feet high; and the clusters of shrubbery were widely spaced, in some cases hundreds of feet apart. We hesitated, not knowing whether to venture into the comparative exposure of the plain, or to veer off to one side, keeping in the shelter of the trees. At that moment my eyes discerned something far out on the prairie, coming swiftly towards us.

"Look, Red, look!"

Red followed the direction of my finger. "It's a man!" he exclaimed. And a moment later; "By God, there's something chasing him!"

There was! Something that ran low in the grass, whose course could only be determined by the agitation of the blades. It was gaining on the man. The latter swayed as he ran, his naked chest rising and falling convulsively. Almost at the forest's edge he stumbled and fell. Then the thing that pursued him, invisible until now, pounced upon the fallen body. Good God! we could hardly believe the evidence of our eyesight! The assailant was a nightmare; a gigantic beetle, three yards in length, its knee-high body raised up on six many-jointed legs shining like metal. Jutting from either side of its loathsome head were pincers that seized and lifted its unfortunate victim as if he were a feather. Two eyes the size of saucers glared at us malignantly; there could be no doubt that the monstrous insect saw us. Still gripping the man in its pincers it began creeping forward, slowly, implacably. The cold sweat oozed out on my brow. What use to flee? The thing could overtake us in a hundred yards.

Red gripped my shoulder: "Your gun, man! Aim at the right eye; I'll take the left. And, for God's sake, don't miss! Now!

The giant beetle was within a dozen yards of us when we fired. Through nervousness I fired twice. Three bullets went crashing into the creature's glaring optics; one into one eye, and two into the other. The glazed surface of the eyes shattered like so much glass. Convulsively the creature

reared its glittering length into the air, its pincers dropping the man. Madly it writhed, clawing at its tortured eyeballs; then, whirling in its tracks, it made off blindly in the direction whence it had come. Whether it was mortally wounded or not we could not tell. The man who had been saved from its clutches, so fortunately, crouched on the ground. At our approach he grovelled in fear.

"There is nothing to be afraid of," said Red, speaking kindly.

The Murlos

HE patted the man on the shoulder, and we picked him up and examined him for wounds. The fellow was entirely naked; strangely enough, except for two dark bruises on his thighs where the pincers had gripped him, he appeared uninjured. In a soft, slurring speech which we could not understand, he spoke to us, pointing in the direction from which he had come.

"Here," said Red, "is our opportunity to get somewhere."

On a piece of cleared earth, he made pictures for the man; with his fingers he modeled the outlines of great globes. To the best of our ability, we tried to indicate that we had run away from them, that we wished to go with him.

The man was intelligent. At the images of the globes his expressive face clouded with fear and rage. "Aih! aih!" he chattered, pointing darkly in the general direction from which we had come, and shaking his fist. Then he pointed another way, walking off a short distance and beckoning us to follow him. We understood and obeyed; whereon he smiled and plunged rapidly ahead, having seemingly regained his depleted strength. Once he paused and rooted out tubers of some unknown sort, which he ate and offered us. We found it soft and mealy, wonderfully well-flavored.

In a short time, the land began to rise into a series of hills. After several hours of walking, and while crossing a broad table land, our guide suddenly took to earth, disappearing into what seemed to be a hole in the ground. Naturally, we hesitated to follow him; but our failure to do so brought him back to our sides, explaining, imploring. "Ro-ro," he chattered: "Ro-ro."

"Well," said Red, "I don't like it; but I guess it's up to us to take a chance."

I looked at the hole doubtfully; it was hardly bigger than a rabbit's burrow. Yet, after Red had followed him, I got down on hands and knees and did likewise. The passageway went down steeply, but after a few yards straightened out. Soon we were able to walk upright.

Far ahead was a flickering light which we approached; and in a few minutes we emerged into an underground chamber in which perhaps a hundred people—men, women and children—were gathered. Later, we found that tunnels radiated to hundreds of other such chambers, and that the whole countryside in this vicinity was practically a vast warren; not of rabbits, but of human beings!

The air was pungent with the acrid smoke of many torches. The smoke hung in a cloud against the rough roof of the cavern and escaped through numberless holes and tunnels leading to the outer air.

As the days passed, and we picked up a knowledge of their simple tongue, Red and I came to an understanding of the history of the Murlos (for so they called themselves). Once the Murlos had been a numerous people living on the surface of the ground; but the Bipos, the bird-masters, had hunted them down ruthlessly, exterminating whole tribes of them and enslaving other Murlos, whom they domesticated and bred for food. So ran the tales told us by the old men of the tribes, passed down to them by their fathers; and they in their turn, were handing them on to their children and grandchildren.

"Look, you," said one old man slowly, so that we might follow him, "no creature, not even Gleilo, the giant beetle, is equal to the Bipos. They are evil and mighty, having great squatting places made of stone and strange substances; and they are able to fly through the air in round balls that glitter. In all the land they are supreme, spreading death and destruction. They come into our forests and lay them waste; they tear up our feeding grounds. Then, when food is scarce and the hunger is upon us, and we enter their fields, they put evil stuff on the growths; so that having eaten of it we become sick and fall asleep. We awake to find ourselves prisoners. And they organize hunting parties and hunt us down with Jahlos"—(the creatures we were to see later)—"Aih, aih! mighty and cruel are the Bipos."

Red and I listened to these tales with horror and indignation. But yet, why should we? Did not men, on our own earth, slaughter cattle, hunt other animals for food; do to the lesser beasts that hindered him and ravaged his crops, what the Bipos were doing here? Yet the whole thing was revolting to us. Man should be the supreme creature, man! Yet here it was not so. In this world men were the cattle; the beasts to be controlled for the good of a superior species, or poisoned and killed off.

"But why don't you fight back?" we exclaimed.

Fight? Fight? No, they couldn't fight, they said. In the dim light of the flickering torches we could see the Murlos' nostrils twitch like those of frightened animals. All they could do, when they saw or scented the Bipos, was to run and hide.

In one of the tribes was a stalwart youth who had escaped from the Bipos. For nearly three years he had been a pet of the young of the bird-masters; and he liked to talk of what he knew concerning them.

"Aih," he said, "it is true. They speak to one another but make no sound. And they do not hear us! I have howled and screamed in their presence,

but without their heeding me. Thus I know they think us incapable of speech."

We thought of our own attitude towards "dumb" beasts. Did not earthly man deny a language to cats and dogs, to sheep and creatures of the wild; simply because human ears could not understand their sounds? I even remembered reading once of a bird which sang, a bird whose throat could be seen pulsing with the melody of its song; and yet a man, listening, was unable to hear a note. Either the Bipos spoke in sounds so high we could not hear them, or sounds too low.

CHAPTER IV

Coming of the Bipos

EVERYTHING about the Murlos was primitive; their habits, their thoughts, their speech. Perhaps I have given the impression that they expressed themselves freely, but this was not so. Their vocabulary was limited. One word, according to the inflection of the voice, the explanatory wave of the hand, could designate many things. All their words ended in vowels, usually "A" and "O". Yet it was an easy language to learn, and to understand.

Fire, the Murlos had discovered, and they made themselves implements of sharpened stakes; not for offense or defense, but simply for digging up roots or tunneling new passages. When attacked, they usually dropped everything and fled to their burrows and caves. Of all the creatures of the wild, they were the most timid and inoffensive; and, of all the creatures of the wild, they were the most preyed upon. We were made aware of that one day while digging for tubers. A wolf-like beast leapt into the midst of our group and felled a woman. All the Murlos incontinently fled; but Red, charging the beast with his sharp stake, pinned it to the ground, and I, hurrying up, dispatched the animal with repeated thrusts. It seemed to be the first time the Murlos had ever realized that their enemies could be slain. They came out from their burrows and danced around the dead body, shouting and singing.

"Lord," said Red, "if they'd only get over that habit of stampeding!"

Living the incredible life of the Murlos, Red and I lost track of time. Insensibly we merged our identity with theirs, became one with them. And this was but natural; for, after the first days of despair and readjustment, to whom could we turn, with whom affiliate ourselves, if not the people of the caves? Nor did we find them unattractive. Though living in the ground, the Murlos were a cleanly folk, bathing frequently in underground pools. Their features were well-formed, and many of the women decidedly handsome. A certain orange-gold maid made shy advances to Red! and as for me—!

To fall in love at any time and any place is a significant experience; to have that love returned is to pin one's hopes and desires to the person of the beloved, to accept with more or less resignation whatever environment may surround her. "Your people shall be my people," was the age-old cry of Ruth going into exile. So it was with Red and me. We loved, and in our love we were resigned to our fate; and out of our love sprang up great hopes and ambitions. We would train the cave folk to fight; we would organize them into a great tribe, a nation, and man would win to power and to importance in their world, as already he had done in ours.

So we dreamed—poor fools—little realizing the overwhelming strength of the Bipos! And yet we might have known. It were as if the lion would lead the antelopes against civilized man.

Saitha had given herself to me with the customary rites of the tribe; all night she lay in my arms in the cave. When morning came we prepared to sally forth with the rest of the Murlos to the watering place. It was at this moment that See-lo, the Tawny One, he whom we had rescued from the giant beetle—fortunately very rare—came rushing into the cavern, shouting hysterically: "The Bipos are coming, the Bipos!"

Distraught with fear, the cave folk began to run this way and that, some of them huddling helplessly together in the middle of the squatting place. Red seized See-lo by the shoulder:

"Show us! Where?"

The Tawny One, though shivering and shaking, led us to a tunnel; but further he would not go. Bidding him wait with Saitha for our return, I followed Red to the surface. Hugging the long grass by the burrow entrance, we looked about us. Perhaps a quarter of a mile away, there towered a great globe of shining metal. To right and left, and behind us, were others; four in all. Even as we looked, we beheld the Bipos, the Bird-masters. And not them alone! We saw the horrors they led on leashes, long, snaky monsters like gigantic weasels, four writhing tentacles starting from their shoulders.

"In the name of God," I whispered huskily, "what can they be?"

We were soon to know. Back in the squatting place Saitha told us:

"They are Jahlos, the snaky ones!"

"And what do they do?" asked Red.

"They enter the burrows," replied Saitha, shuddering: "They hunt us through the caves and the runways. They strangle us with their terrible tentacles, wrapping them round our necks. They tear at our throats with their long green fangs and suck our blood. They drive us into the open where the Bipos take us or slay."

"Aih, aih!" groaned See-lo, squatting on his hunches and rocking back and forth with fear: "We are doomed men; we are lost."

Red and I stared at each other with terror. As human beings used ferrets on earth to exterminate

rabbits, so the Bipos were hunting down the Murlos with their horrible animals.

"Good God!" breathed Red. Then he straightened up: "But we mustn't lose our heads; we must keep together and fight."

We gathered as many Murlos as possible in one body: See-lo, Saitha, Red's mate Go-ola, and a score of other men and women. It was hard work keeping them together. We pleaded with them, cajoled them:

"If you flee, panic-stricken, even to the most secret of your caves, surely the Jahlos will find you out, kill, or force you into the open," cried Red, "but if you stay with us you will be safe. We men from earth know how to fight Jahlo. He is afraid of fire. All animals are afraid of Bunola, the burning one!"

Feverishly we armed our little band with blazing torches, heaping up great piles of the dry grass and reeds on which the Murlos had bedded. Then, forming a circle, with the women and children in the center, we waited. Only Saitha crept to my side, and I hadn't the heart to chide her. Soon a strange whining sound was heard from all the winding tunnels and runways. The women and children began to weep in abject terror, the men to sway and moan. Even Red and I felt the chill flesh quivering on our bodies.

"It is the noise the Jahlos make when they hunt," said See-lo; and one old man began to chatter terrified: "Surely we are fools to abide here; there is no safety but in flight!" Throwing down his torch, he scampered like a frightened hare to a far burrow, and was gone. For a moment there existed grave danger of the rest following his example, but Red and I held them.

"Listen, O men of the Murlos," he thundered: "Always have you fled before the Jahlos, and always have many of you perished. But the Jahlos are afraid of fire, of Bunola, the burning one. We swear that this is true! Besides—" he brandished his automatic—"here in my hand is death-dealer, the thunderbolt. Let See-lo tell you how it overcame Gleilo, the giant beetle. Surely Jahlo cannot slay Gleilo!"

Fighting the Jahlos

AND while the Tawny One told, for the thousandth time, of his miraculous rescue, Red whispered to me: "If those damnable monsters aren't afraid of fire, then God help us!" Even as he spoke, a long slinky body, with nightmare-like tentacles writhing this way and that, glided from a nearby tunnel into the cavern. At sight of it a terrified wail went up from the Murlos.

"Jahlo!" they screamed, "Jahlo!"

The hideous creature flattened itself on the cavern floor and eyed us malignantly, evidently puzzled by the array of torches it faced.

"See," I shouted, "Jahlo is afraid!" And with the words I leapt forward several feet and hurled my blazing torch into its face. With an appalling screech the monster recoiled, its back arched, spitting like a cat. I returned to the circle without my brand; but its loss was more than compensated for by the courage my act had put into the Murlos. Like children they danced about, excitedly screaming: "Jahlo is afraid! Jahlo is afraid!"

And now other snaky beasts stole into the cavern, veering away from us into runways and burrows leading further into the bowels of the earth. Soon we could hear the heartrending screams of cave-folk discovered in their hiding places; screams that went up hideously and ended in a gurgling note. Terrified Murlos dashed through our cavern, pursued by destroying demons. A few we rescued, drawing them to safety behind the bonfires we had lit, and through which no Jahlo dared to leap; but the great majority of them, insane with fear, fled blindly into other tunnels, where they were overtaken and where they died horribly.

So the ruthless hunt went on for hours and hours, it seemed. Finally silence fell over the burrows and the runways; the strange whining sound of the Jahlos was heard no more. After a while Red and I ventured to go to a burrow entrance. The round globes were gone; the Bipos with their hunting monstrosities had disappeared. The plain was empty. Sure of this, we returned to our little band, and began the dismal work of computing our losses. Two-thirds of the inhabitants of our little band had been wiped out. From places where they had successfully hidden, Murlos began to emerge; but the number of those who had thus escaped the murderous fangs of the Jahlos was pitiably small. Red and I were surprised to find so few dead bodies—a dozen all told—when hundreds had been slain; but See-lo explained: "The Jahlos, after sucking the blood of the dead fetch them to their masters, the Bipos, who carry them away for food."

It comforted me little to reflect that earthly men retrieved birds with dogs, after shooting them, in somewhat the same fashion. "The Bipos are merely acting like highly-civilized human beings," I said to Red. He nodded gloomily.

"I believe the Murlos have learned a much-needed lesson."

They had.

Henceforth they would not flee before the onslaughts of Jahlo, but protect themselves with Bunola, the burning one.

"To run is to perish," said Red solemnly! "Those who use fire and stick together will live. Always you must keep the caves supplied with resinous woods for torches and bonfires."

"Aih, aih!" agreed the ones who had stood with us in the circle. "Truly speak the Keepers of Thunder." For so they called Red and me.

CHAPTER V

The Bipo Scientists

IT was several days after the tragic events recorded above, that the two of us set out on a journey of exploration. Beyond their own

rather restricted territory, the cave-folk had but vague ideas of the surrounding country. Far away, they indicated with indefinite gestures of the hands, lived other tribes of men like themselves. How far? They didn't know exactly; none of them had ever been such a distance; but over there somewhere.

"We must meet those other tribes," said Red. "Make an alliance with them; unite them with our own if possible."

We were full of ambitious plans; plans that had to do with the making of weapons. "Arm the Murlos and teach them to fight," said Red: "They're timid now, but when they win a few battles. . . . ."

Perhaps we had become a little careless. For several miles we had walked without encountering anything more formidable than a large, sloth-like creature, which crawled peacefully out of our way. Our sense of danger was lulled by the monotony of the journey, the heat of the sun, and the heady perfume of great purple flowers which seemed to bloom everywhere. Thus, when we passed from a dense thicket into a cleared space and found ourselves not twenty yards from a group of Bipos, we were utterly surprised. Seeing us, one of the bird-masters slipped the leash of a Jahlo; and the savage creature, with its strange, whining cry, came hurtling towards us! Red had but time to throw up his automatic and fire, bringing the beast mortally wounded to earth almost at our feet. Before we could turn and flee, however, one of the Bipos pointed at us a shining object from which leaped a grayish smoke. We were conscious of being arrested in every limb, of an inability to move either legs or arms; yet we did not lose our senses. Helplessly we watched the Bipos surround us and view the dead Jahlo with every manifestation of surprise. Our automatics they examined closely; ourselves they subjected to minute scrutiny. At last we were half-carried, half-dragged to where, at some distance, stood a glittering globe among tall trees. Once again the Stygian gloom of the interior of this strange air-craft surrounded us; we were thrown into a sort of cell, the extent of which could be ascertained by groping about.

"Those creatures evidently don't need lights to see by," said Red. And then: "By God, what fools we were to stumble into their hands like that!"

I thought of the barn-like structure from which we had once escaped, the stalls in which human beings stood tethered like cattle, the enclosure which reminded one so much of an annex to a slaughter-house, and my flesh crawled. Not so easily would we elude our captors again!

"And this time they've got our guns," said Red.

It was with fearful misgivings (our power of movement having returned shortly after our incarceration) that we stepped from the globe into the light of day. Even at that moment, I wondered how the big spheres were propelled through the air. Again we saw the orderly rows of glittering globes, and ahead of us the cluster of big buildings; but this time from a different position. Instead of our being conducted into what were evidently their cattle sheds, the Bipos led us to a more pretentious building, which rose several stories. We ascended to the top floor, not by stairs or lifts, but by means of a spiral chute up which an open car glided. The method of propulsion we could not see. No pulleys or cables were visible anywhere. We just stepped into the conveyance and it started.

At the end of the ascent, we found ourselves in a large room. There could be no mistaking it—though the instruments and objects were all strange to our eyes—it was a great laboratory. Though we knew the Bipos to be intelligent, we had not given them credit for the science revealed by this room and its furnishings. There were, perhaps, fifty of them gathered together in this one place, all of them engaged in doing curious things. Then we saw arranged on one side of the room great glass bottles in which the bodies of animals—some of them unbelievably weird and hideous looking—floated evidently in a preservative fluid; much as earthly scientists keep various things in alcohol. Among the bodies thus preserved we saw those of several Murlos!

The assembled scientists—surely they could be nothing else—regarded us with interest, evidently talking with our captors; for their blunt bills were opening and shutting, but emitting no audible sound. It was uncanny. The automatics were again subjected to scrutiny; then our own persons and our tatters of clothes. Plainly the Bipos were puzzled; they disputed among themselves. Finally they seemed agreed as to their plans.

A lizard-bird—there were several of these monsters in attendance—brought from some adjacent place a frightened Murlo, recently captured. Red and I tried speaking to him, but he chattered in a dialect strange to our ears. The Bipos placed this Murlo in front of a huge machine, on the face of which was an opaque, cream-colored slide. Behind him they arranged another machine, with a projection shaped like a gramaphone horn, the mouth of which was trained on the back of the Murlo's head. Then a switch was thrown.

At first we did not realize what was happening. Seemingly uninjured, the Murlo stood immobile. Not until the Bipos placed us, one on either side of him, did we grasp the stupendous ingenuity of the thing which was taking place. On the opaque slide the thoughts of the Murlo were being pictured. Red and I stared, fascinated. We saw glimpses of runways, burrows that were a black blur, caverns lit with the dull flare of torches. And green stretches of meadow we beheld mixed chaotically with red waves that we interpreted later to mean terrors or passions. The mind of the Murlo, as shown on the slide, was a twisting, squirming thing, incoherent, jumbled.

The Thought Words

THE Bipos watched us closely to see if we understood. Red pointed to the slide, to the

Murlo's head, then to his own; "Yes," he said: "I understand; you're trying to talk to us!"

The Bipos were visibly excited. Removing the Murlo from between the machines, one of their number took his place. The thoughts of the Bipo registered on the slide in clear, definite pictures. Strange things we saw; weird, wonderful. Not all could we understand—there were gaps, hiatuses—but he was telling us that his was a mighty race, a ruling species. There were pictures of great cities, of broad causeways thronged with one-wheeled vehicles and others that defy description. More he gave us to understand, much more; but it is impossible to put it all down here. We learned, however, that the group of buildings, in one of which we stood, was but a small outpost in the wilds for the raising of food-stock, for the scientific investigation of wild animals. And then he showed us the Murlos. His name for them was a purple splash. They were pests, over-running the country, eating the crops. They were unintelligent, stupid, and their thoughts registered as vague, blurred pictures—chaotic, disconnected, little better than those of other animals. So he came to us.

"But you," he seemed to be asking, "you who appear to be Murlos, though of a different color, who fight with strange weapons"—(here there was a picture of an automatic thrown on the slide, a picture of us shooting the Jahlo)—"who fight with strange weapons, a thing no Murlo ever did before: who are you?" he seemed to reiterate with a great burst of color. Then he moved away from between the apparatus.

Without hesitation Red took his place. Instantly a picture of both of us appeared on the slide. "I am a man," said Red aloud, "a man!"

At his words the slide became suffused with a hue of violet, shot through with deeper purple.

"And I come from—"

A picture grew of Seventeenth Street, Denver, Colorado, with the Mizpah Gate showing in it; and behind it the Union Depot. The Bipos were following the picture, enthralled, their single-glass lenses gleaming. Red showed the puffing locomotive, the long train of cars, ourselves seeing Levine aboard and then driving along miles of macadamized road in the Buick roadster; the arrival at Pueblo. He showed the streets crowded with street cars, automobiles, hurrying people. Then it was dark night, and we were crouching in the rear of Sanborn's shop, sawing at a door. Step by step he developed his story, until the laboratory above the chemist's shop was revealed, until we stepped upon the metal plate.

Then there was a gap! I was shivering in every limb. The slide plunged into blackness. Out of that blackness there something grew, huge, immense. Bigger than the slide in the machine; bigger than the laboratory of the Bipos, the bird-masters. The crystal brightness of it turned into a thousand sparks that flamed across the universe, that whirled and danced in a nebula of suns. My body grew, expanded, engulfing moons, planets, solar systems. And then—out of a delirious, disintegration of spinning atoms I fell: fell with a sickening thud on the wooden floor of Sanborn's workshop!

So it was that we came back!

CHAPTER VI

Back to Earth

YES, we had come back. The four walls of the chemist's room were around us. We were not in the cathode tube, but lying on the floor some feet in front of it. The sickening thud had been caused by our being dragged from the glass chamber and dropped.

Sanborn had hauled us forth. His cavernous face, full of concern, was the first thing I saw as he gave us liquid to drink. Strength flowed into our bodies, our senses cleared.

"You are all right," he said, "all right now."

Physically we were; but mentally we found it rather difficult to adjust ourselves to the present environment after our sudden transition from the land of the Bipos. Curiously, it was the chemist and his workshop that seemed unreal; our earthly existence seemed like a dream.

Sanborn told us that this was only natural. "But the feeling will wear off," he declared. We asked him what power had brought us back; and he answered that when it seemed to him enough time for the experiment had elapsed, he had simply reversed the switch.

Everything that had travelled with us into the unknown had come back when he did so. The two automatics were lying on the bottom of the tube. Several pieces of cloth, torn from our clothing by thorns and thickets had returned. All the bullets were accounted for, even to the one that had shot the Jahlo; and on the curving glass lay a thick dust of material which had once been incorporated in our bodies. Our equipment, also, was changed by time and wear.

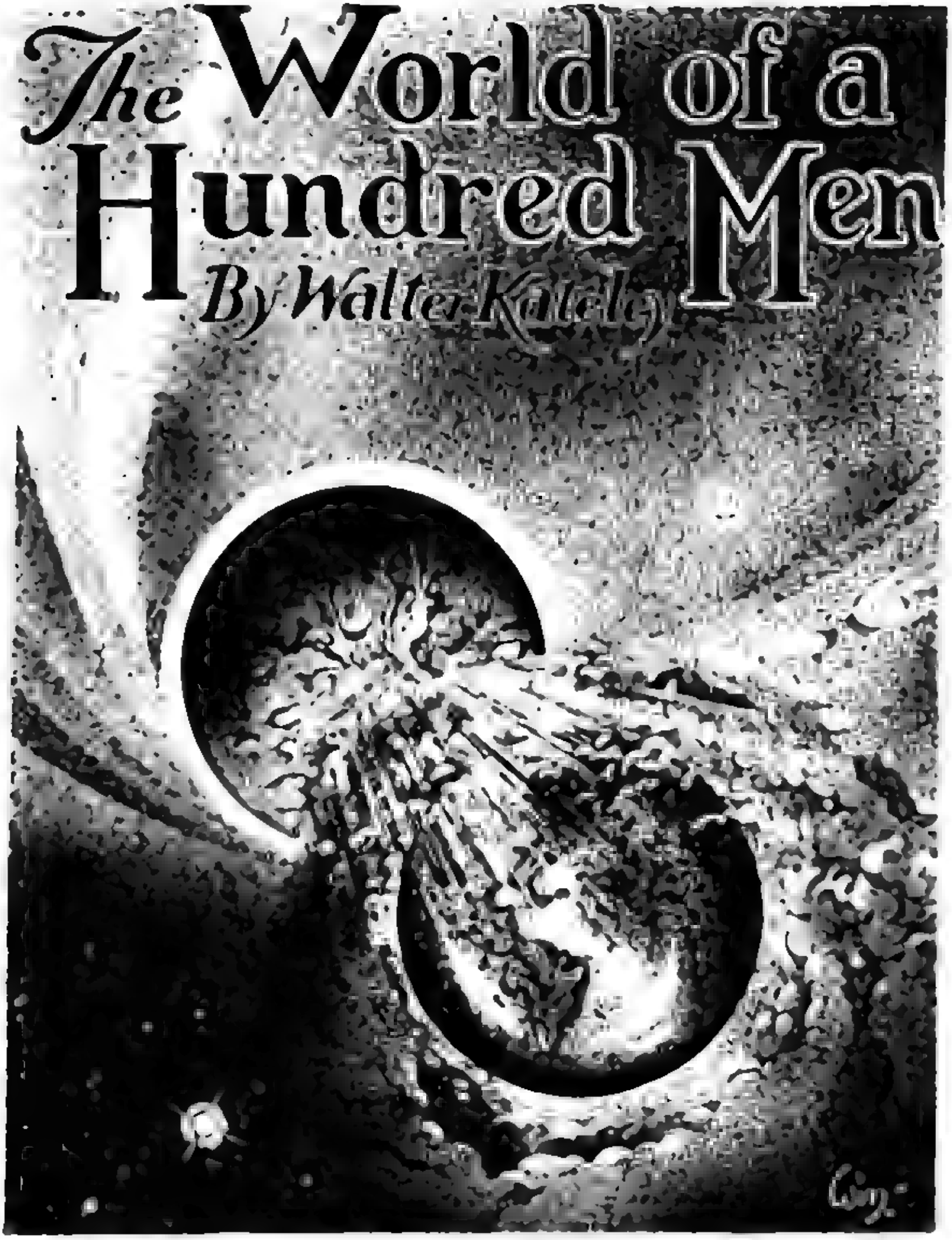
In every way we showed the effects of weeks of rough living. Our garments were in shreds. Creeping through burrows, often on hands and knees for hundreds of yards, fighting through thickets and tangled growth, is not conducive to the welfare of clothes. And there were hard callouses on our knees and on the palms of our hands; scratches, scars. Finger-nails were broken, uncared for; our hair was unkempt, our faces covered with straggly beards. Before our incredible adventure Red and I had been soft, a little fat; pale with the pallor of men who live in cities, sleeping mostly by day and prowling at night. Now we were lean and hard, our cheeks and the exposed portions of our bodies burned a greenish brown from that strange sun.

We told Sanborn where we had been, what had occurred; told him of the Bipos, the Murlos, our weeks of living in the human warren.

(*Concluded on Page* 840)

The World of a Hundred Men

By Walter Kateley



(Illustration by Wiz)

The strange planet must have passed so close that its atmosphere came in contact with that of the earth, generating an intense heat. This heat caused the oceans of Venus to evaporate and assume the form of rain and mist.

IN view of the important results of our Expedition, it seems fitting that I should chronicle it somewhat more fully than was practical in the official report that I prepared for those who were the financial backers or scientific advisers.

I think I may say advisedly that our experience is entirely unique in scientific research. But there is so much of purely human interest in our discoveries that I am going to try to tell of them in simple language, that they may be understood and appreciated by the layman as well as by the scientist.

WALTER KATELEY

I am, and have been for a number of years, an examiner in the patent office. About two years ago, I received a letter from Mr. W. Kingston. (Lest you might not recognize the name, I will say that this is the Mr. Kingston who first invented the process of altering the proportion of electrons and protons in the atom; and who was the originator of the process, now becoming so common in industrial laboratories, of altering the nature of certain basic materials.)

The letter was only a note, saying:

"My dear Explorer: I have plans for discovering the great meteor in Diablo Canyon, and I most cordially invite you to accompany me, and finance the expedition."

I replied; "My dear Mr. Kingston: I am profoundly grateful for the honor you have conferred upon me, and I assure you that I am very much interested in your project. But in regard to the financing, I regret to have to advise you that, not knowing of this splendid opportunity, I used my available funds to pay the first instalment on an encyclopedia. However, I will call at your home next week, and possibly we can discover some way in which I can be of service."

Of course he was well aware that I was not a man of means, being only an employee of the patent office. There was a note of humor, too, in his calling me an explorer; because the eventful trip I once took, starting from his laboratory, was entirely involuntary and unpremeditated. (This was the strange trip to the "Fourteenth Earth," the account of which was made public last year.) But what about this strange meteor business?

I knew that a great deal had been written from time to time about this great hole in the earth, supposedly made by a meteor. But I didn't know how much of it had been fanciful, and how much based on hard facts. So I repaired to the scientific reference room of the patent office, and made a systematic search for data on the subject.

For the benefit of those interested, I will say there is a very good description, and some good photographs of the crater in the book entitled "Meteors," by P. Olivier, Associate Professor of Astronomy at the University of Virginia, and Astronomer at the Leander McCormick Observatory.

I also found three articles in the *Engineering and Mining Journal Press* for Dec. 6, 1924, Feb. 7, 1925, and Nov. 20, 1926, respectively.

From these eminently authentic sources, I learned that this crater is in the vicinity of Canyon Diablo, not far from Flagstaff, Arizona. It is on a large plateau, sometimes called Coon Butte, and sometimes alluded to as Meteor Mountain; and is quite a number of miles from any traces of volcanic activity. The crater is about three-quarters of a mile in diameter, 3,900 feet, to be exact, and six hundred feet deep, encircled by a rim of debris 160 feet high. This rim is composed largely of flour-sand and huge blocks of limestone, some as big as a church.

The inside of the crater and the surroundings are strewn with iron meteorites, over eighty tons of which are known to have been picked up. This is more than has been found in all the rest of the world.

Not long ago, the United States Smelting and Milling Company carried on extensive drilling operations, and sunk a number of shafts in an attempt to locate the meteor, believing that it would contain minerals of great value. This work was carried on under the direction of a Mr. Holland, of Inspiration, Arizona; and although they penetrated to a great depth, only fragments were encountered.

The meteorites found are nickel-iron, containing about eight per cent nickel, and an appreciable amount of platinum. I was quite astonished by this array of facts; for I had no idea of the magnitude and importance of this crater, and I was ready to believe that if the meteor could be reached, it could not help but be a great boon to science, even

THE recent activities of scientists at the Barringer Crater in Arizona show that interest in this mysterious phenomena is by no means dead. Efforts to determine the nature and the cause of that great hole in the earth has existed for some time. Since there have been found in this gigantic crater parts of meteors, theories have been advanced attributing the hole to the fall of a tremendous meteor some time in the past.

In his "The Stellar Missile," Ed Earl Repp advanced one theory as to the probable cause of the Barringer Crater. In the present story, Mr. Kateley also gives an explanation which is based upon the most excellent science. While we cannot state with certainty that the eventual solution of the mystery will prove to be similar to Mr. Kateley's explanation, yet there is no doubt that Mr. Kateley has used all the available facts to the utmost and has exacted a most convincing story. This is an interplanetary story par excellence.

though it might prove to be of no great commercial value. The more I thought of the scheme, the more my enthusiasm grew, till it filled my thoughts by day and my dreams by night.

I received the scientist's invitation a week before I had planned to take my annual vacation; and as Mr. Kingston lived in my own state, in fact only a day's drive from the old homestead, I was impatient to go to see him. I considered him one of the foremost scientists of the country and I had long hoped to persuade him to give me an account of his adventures for publication.

So upon getting home, I lost no time in going to see him. He received me at the house, but conducted me almost immediately to his little laboratory on the back of the lot, built in the side of a steep hill.

The Departure

I FOUND him a tall, light-complexioned man past middle age, of rather a studious appearance, and very pleasing manners. He has a half-humorous way of speaking of his scientific accomplishments which, while not detracting from their importance, indicates that he doesn't take himself too seriously.

I was rather surprised to learn that his science was only an avocation, and that he was regularly employed as a designer in the offices of a brick and tile machinery manufacturer.

He plunged immediately into the details of his plans for the expedition, which included the use of a burrowing machine, and the employment of his own invention that I have mentioned above. By treating the excavated soil with *Transite*, he hoped to be able to reduce its magnitude and density to such an extent that it could be stored in the tunnel, thus avoiding the labor of carrying it to the surface.

He was very enthusiastic, and laid the proposition before me in such a convincing manner that I very readily agreed to make an attempt to interest such organizations and societies as we hoped might contribute funds for the expedition. We decided to go immediately to Arizona, and visit Meteor Mountain and there perfect our plans.

So two days later, we took tickets to Flagstaff, and boarded the train that was to take us to that famous crater that has been so often photographed, and about which so much has been written during the past few years, in Sunday supplements and scientific magazines.

When we arrived, we found the situation much as had been depicted in the various publications, except that there was a far greater desolation than we had imagined. We were both surprised and awed by the tremendous magnitude of the crater, and the amount of debris heaped up around it. Cold figures and mere pictures cannot give one an adequate idea of it, any more than one could gain a correct idea of Niagara Falls from books and pictures.

We were quite ready to agree with Mr. Holland, who says in the Engineering and Mining Journal Press of February 7, 1925, that more earth had been thrown out by the impact than was dug up in building the Panama Canal.

We descended into the crater and prospected around in the sand with a magnet for fragments of meteor that are said to be so numerous there. At length we found two of them, and Mr. Kingston put them in his bag to take home for analysis.

We wanted to know what kind of ground we would have to deal with, for we hoped to alter the atomic density of the predominant element in the sub-soil in such a way that it would occupy much less space than at present. Kingston said that roughly speaking, the structure of a molecule of ordinary limestone soil was made up of electrons and protons in the ratio of about nine to one. Then if one electron could be eliminated from each unit, the atomic density would be increased, and the bulk decreased accordingly. Just what the nature of this resulting material would be, he could not say without actual experiment.

So we gathered up some of the earth on the top of the dumping from the deepest of the earlier excavations, which we judged would be fairly representative of the deposits we would encounter, and prepared to transfer the scene of our labors from the wilderness to the little side-hill laboratory in our native state.

Needless to say, this part of the work devolved very largely upon Mr. Kingston; for, while my training and my work in the patent office has rendered me fairly well acquainted with chemical formulas and electro-mechanical devices, I am still far from being a finished scientist. And this business of tearing down and reconstructing the atom was to me about what differential calculus is to the South Sea Islander.

However, these little units of matter which are becoming so familiar in industrial science, and which Sir Oliver Lodge so aptly likens to miniature solar systems, held no mystery for Mr. Kingston; and he felt sure that he could prepare a suitable *Transite* for this particular soil. This *Transite* as I have said, was his own invention, for which he has taken out various patents, and which has brought him into prominence as a pioneer in this line of work.

Early one Monday morning, we carried our grip-load of material into his laboratory, and commenced work. And there followed a period of intensive application, in which the nights and days were all jumbled together, until we hardly knew whether the sun was coming up or going down. As I look back, my memory is so confused with a procession of test tubes, retorts, vacuum tubes and electrical devices, that I hardly know what we did. Indeed, I didn't know what I was doing at the time; I was

just following directions, and doing as intelligently as possible what my leader instructed me to do. And from his optimistic mood and growing enthusiasm, I gathered that we were making prog-

CHAPTER II

A Discovery

AT length, after nearly a fortnight, we brought forth a brick, about an inch thick, an inch and a half wide, and three inches long, and about as heavy as zinc. We found its specific gravity to be slightly more than 7, while that of the sample of original earth of which it was composed, compressed as compactly as possible with the facilities at hand, was about 5. The breaking resistance was nearly equal to that of common soft brick.

Here, then, we had the data for determining the size of the hole we would have to dig, to secure a clear opening of any desired area. We decided that about eight feet in diameter would be as small as would be practical. Hence the entire excavation would have to be about 15 feet in diameter, leaving a lining approximately 3½ feet thick.

Having accomplished this much, we rested. It was high time, for we were both very tired; and besides, my vacation was nearly over. And as Mr. Kingston's allotted vacation was also drawing to a close, we decided to part and divide the work of preparing for the expedition. He was to devise the exploring apparatus, and I to raise the necessary funds.

I took up my duties as examiner once more, but I had little heart for it. My mind constantly returned to what might be buried in that mountain. I suspect that Mr. Kingston's work also suffered from lack of enthusiasm; for every week-end he wrote me of his progress in designing the tunnelling machine.

About three weeks after my return, I received a short, apparently hastily written note from him saying: "I am convinced that our meteor is an asteroid, as I have just found unmistakable fragments of fertile top-soil in the samples we brought from the mouth of the shaft."

I was very much surprised at this information, and as I recalled the barren, desert-like aspect of that arid district, I felt sure that if there was surface soil of any marked degree of fertility, it must have come from the falling body. But as to the nature of asteroids, I freely admit I was a bit hazy. The astronomy of my college days is buried under a twenty-year deposit of rust. So I went again to the research library, and asked the librarian for some authority on asteroids. She brought me C. G. Abbot's recent book, "The Earth and the Stars". (Mr. Abbot is assistant secretary of the Smithsonian Institution.) I will quote a few lines from his chapter on asteroids.

He says, in part: "Between the orbits of Mars and Jupiter lies a large gap of space, in which, according to Bode's law, should be a planet 2.8 times as far from the sun as our earth. Beginning about the year 1800, astronomers have been filling this gap with little planets, none of them nearly as big as our moon, and ranging from a diameter of 500 miles down to, comparatively speaking, mere rocks of but a few miles in size. In all, nearly a thousand have already been found, and it seems probable that if we could detect every one, however small, the number would be almost countless.

"Nowadays they are discovered by photography.

"Some of these bodies are variable in their light, which means that one side is reflecting more than the other. This gives a chance to measure the time of rotation for a few of them. Eros sometimes comes within 15,000,000 miles of the earth, much nearer even than Venus. Such occasions offer the most favorable opportunities for determining the scale of the whole solar system, including the earth's distance from the sun. Unfortunately, the most favorable one occurred in 1883-4, when Eros had not been discovered. In 1900-1, the opportunity was fairly favorable. Another favorable occasion will come in 1931.

"The late Professor Watson discovered a good many minor planets. He felt such a fatherly interest in them that he made a provision in his will for a trust fund, called the Watson fund, in the custody of the National Academy of Science, to be devoted to the 'promotion of knowledge of the Watson Planets and closely allied subjects.' "

It seemed to me quite reasonable to suppose that one of these little worlds which at times come so near the earth, might have deviated from its orbit, and been caught by the earth's attraction. In that case, no wonder there was rather a large hole at Canyon Diablo.

The probability of an asteroid apparently stimulated my co-worker to greater effort, for before the first snow he had his drawings all complete, and an application for patent filed on the tunnelling machine.

Then it was my turn to get busy. I prepared a list of all the organizations that I thought might be interested in this kind of research work, and then prepared and committed to memory a sales talk that I thought would present the proposition in the most alluring light.

This carefully prepared sales talk, however, proved to be practically a dead loss; for I never had occasion to use more than fragments of it. Either those I interviewed were in too great a hurry, or plied me with too many questions; or at the critical moment I couldn't call it to mind. It did, however, give me a feeling for preparedness, so that by the first of the year I was ready to tackle the entrenched forces of finance.

During my week ends, I visited the offices of the Geographical Society, (the publishers of the Geographic Magazine), the Rockefeller Foundation, the Smithsonian Institution, the National Museum, the

U. S. Geodetic Survey, the Bureau of Mines, the National Academy of Science, and many other public and semi-public institutions, such as colleges and scientific societies. I met with varying degress of success; and by the middle of March I was able to report to Mr. Kingston that I had promise of sufficient funds to warrant the construction of the machine, and the buying of such other equipment as we would need to start the expedition.

One offer from the government was especially gratifying. We were assured of a practically unlimited supply of electricity generated as a by-product at a large reclamation project on the other side of the mountain. This was a great boon, as there could be no doubt that it would require a tremendous amount of power to drive our heavy machinery, and provide current for the *Transite*, and if the work should consume a long time, the cost would soon become prohibitive.

By this time our project had attained some publicity; and the McCrea Brick and Tile Machinery Company, Mr. Kingston's employers, generously offered to build our machine at cost. Mr. Kingston, therefore, left the designing room in order to personally superintend the construction, while I got a few days off to make a flying trip to the mountains to help lay out the route of the high tension line that was to furnish our power.

Early in the spring, I made application to the patent bureau to extend my annual vacation to a three months' leave of absence. This of course entailed a great deal of red tape, for what does the Civil Service care for lost worlds? At length all difficulties were adjusted and on the tenth of July, Mr. Kingston and I set out from the factory with our machinery and equipment on some half dozen freight cars, billed to the station nearest to our now famous crater.

The Meteor Mole

ARRIVED at the unloading station, we commenced the herculean task of transporting this heavy freight over two townships, both of which were practically turned up on edge. With a small army of men, oxen and mules, we made the portage by main strength and sheer force of numbers; and then commenced the task of assembling the machine and storing our supplies. For three mortal weeks we were busy doing necessary nothings; and then the machine on which we had staked our hopes began to take shape. Mr. Kingston called it the meteor mole, and a veritable mole it proved to be.

I will here attempt to give a very sketchy description of the mole, endeavoring to avoid all technical terms, because in this matter of technical description I might easily go to extremes; since in my work in the patent office I have to deal almost entirely in technical terms, until they have become a part of my every-day life.

I hope that this report will be of interest to, and will be read by, a great many more people who have never had any mechanical training. In fact, our researches have already progressed so far that it is evident that their historic, geological and biological importance far outweighs that of any mere mechanical contrivance. But since it was, so to speak, the vehicle of our progress, the mole is manifestly worthy of some attention.

The body of the machine resembled the housing of a much elongated dynamo; as though the sides were pulled apart, stretching it out into a long cylindrical form, perhaps twenty feet long, and a little less than eight feet in diameter. On the front end, and extending forward and to the sides, was the excavating and molding machinery. The forward half of the cylinder contained the motors and controls, etc., and the rear was fitted up as a combination living quarters, machine shop and laboratory. Here was to be our home while the mole was at work.

The machine was so designed that most of its operations were controlled automatically. There was no traction machinery, only a vibrator which was contrived to jar the machine enough to cause it to slide down to the bottom of its own excavation, if the steepness of the grade of our descent was not sufficient to overcome the friction of our contact.

When the machine was in operation, the excavating unit was of course in the foreground, cutting in the form of a semi-circle, with a vertical diameter; while the excavator was on, say, the left side of an excavation, the machine was held stationary by a huge prop extending from the right side of the machine and bearing against the face of the wall at the end of the tunnel. This prop resembled an elephant's leg with a very much distended foot. Mr. Kingston dubbed it "Pes pachydermis." While the excavator was at work, the leg remained stationary; but when the semi-circle was dug to the depth of about a yard and a half, and could reach no more soil to offer resistance, a pressure-governed control automatically withdrew the right leg and extended the left one, and at the same time transferred the excavator to the opposite side, where it again came in contact with the soil and started to do its stuff.

The excavated soil was transferred to a crusher, where it was thoroughly pulverized and passed on to a treating vat, where it was treated with the powerful electric current that was being conducted through the all-important *Transite*. From here, the transformed soil, much reduced in bulk, passed on to the mold, which pressed it into huge blocks, shaped like the building stones used in constructing arches. These were automatically deposited against the inner circumference of the circular excavation, in a spiral formation; where each row was held in position by a chemical until supported by a succeeding row.

Thus, the wall of our tunnel was supported by an arch and an inverted arch, or rather a circular arch

construction. Theoretically, at least, the only human attention the machine required was the renewing of the charge of *Transite* as it became exhausted. This charge, like that of a storage battery, was rather short-lived.

So it was that one day in early August, all was in readiness, as Mr. Kingston so tersely put it, to turn on the juice. I had been busy for the most part with the construction of the supply camp and in storing the *Transite* in carefully insulated sheds; while my co-worker with a gang of mechanics had been assembling the mole; so I had paid but little attention to its appearance for a few days.

It was situated a few rods from the camp; and, on the morning I speak of, there was a very heavy fog on the mountain. As I approached it, it suddenly loomed up out of the mist, and I have a very vivid impression of it, with its rear propped up on some huge logs at an angle of about 70 degrees. It appeared poised for a high dive into the bowels of the earth.

It soon proved that it could dive, but its progress was hardly swift enough to appear spectacular to a couple of impatient explorers. As I came up to the machine, Mr. Kingston was trying out the mechanism; and the various devices were performing in dumb show, for all the world like the tentacles of some great beetle, doing the things which to us seem futile and meaningless, but which to beetles are no doubt of great importance.

So we took up our abode in the meteor mole where we were destined to live for many weeks, and embarked upon such a voyage as no human being had ever experienced, destined to be so full of adventure and discovery that it manifestly marked the beginning of a new epoch of human knowledge, and opened up a line of scientific research that far transcends anything that had gone before. The result of this research laid at our feet the accumulation of knowledge, the wealth of thought, and the scientific progress of a civilization that was masterful and progressive, perhaps a great many centuries before our ancestors emerged from the caves.

But I am getting ahead of my story.

When all was in readiness, the mechanics released the wedges, and allowed the machine to slip down the ways into the shallow, tunnel-like hole that had been dug by hand, in order to give the mole a firm footing, and afford normal conditions for its operating parts.

Then, with no more ceremony than one observes in turning on an electric light, Mr. Kingston turned on the power, and composed himself in his seat, as if his troubles for the day were over. So the meteor mole started to dig, and at last the expedition was under way.

On the whole, everything seemed to work as planned, and except for a few minor difficulties, such as a control motor getting hot and a fuse blowing out, we burrowed steadily for the greater part of an hour. By this time the rear of the meteor mole was well below the surface; and a tunnel wall was developed far enough to assure us of its stability. So we turned off the current and made our final preparations to leave camp.

We established a telephone line and tried out our emergency wireless, and gave the camp superintendent final instructions about how to send us supplies and how to operate the air-pumping device. Then we took formal leave of a few friends and scientists who had come, not without profound misgivings, to see us off.

We took one parting look at the great out-doors, which in this part of the world is nothing much but encircling vastness, and descended into the meteor mole.

CHAPTER III

Into the Hole

ALL the rest of that day, all night and most of the next day we burrowed steadily into the depths, encountering only blue clay and limestone, interspersed here and there with a vein of yellow sand. Then we came upon a huge boulder, no doubt one that had been dropped somewhere in the vicinity by a passing glacier in some prehistoric age. This old boulder proved too hard to be penetrated by our excavator. So we were obliged to telephone to camp for blasting materials and an electric drill. We had rigged a car on broad rubber tires fashioned to fit the curve of the tunnel, and operated by means of a motor-driven windlass and a cable. This was our first occasion to use the car, and we had some misgivings about trusting explosives on the first trip; because if the car should get out of control on this steep incline, it would not be hard to imagine what would happen when it came in sudden contact with the mole. So we let them make a couple of trial trips before we told them to load the explosives. However, the car seemed to be under perfect control, and on the third trip brought us our material.

After no little clambering, and working in cramped positions, I was able to drill a hole deep enough for a blast; and, after tamping in a charge, we attached the battery and withdrew by means of the car to a safe distance, trusting that the mole, being withdrawn a few feet and being constructed so strongly, would not be harmed.

These necessarily close quarters precluded the use of dynamite, which would have been much more effective, and could have been used without drilling. But even if we could have withdrawn the mole to a safe distance, the shock of dynamite would no doubt have crumbled our freshly-laid walls and perhaps wrought irreparable damage. So we thought it advisable to rely on the more tedious method of blasting with drill and powder.

Upon setting off the charge and returning to the mole, we were gratified to find that little disturbance had been caused; but the rock was so well broken that we were able to bury the larger frag-

ments under the floor of the tunnel, and leave the smaller ones to the crusher.

During the next few days, we encountered several of these boulders; but happily none of them was large enough to impede our progress for more than a couple of hours. On the fifth day, we decided to take a day off and give the machinery a rest.

We had been moving day and night since our start, one watching while the other slept. And a great deal of time we were both working, as when we were obliged to blast rocks or prepare our meals. In fact, the days and nights were all alike; and only the chronometer told us whether it was morning or evening. So after taking a good sleep we took account of our progress, and found it had been unexpectedly rapid. By measuring the cable of the transportation car, it was determined that we had made nearly 250 feet each twenty-four hours. At this rate we would make a mile in a little more than three weeks. This was indeed success of an encouraging sort.

At the end of 24 hours, feeling much refreshed and heartened, we said giddap to the mole, and settled down for a long hard pull.

For a period of nearly five weeks our work was comparatively uneventful and even monotonous. I dare say we would have become very tired of the ceaseless noise of the machinery and of the endless routine of the work, with nothing to distinguish day and night, had it not been for an anxiety and alertness for any signs of the object of our quest. There was also the necessity for redoubled activity to devise means for dispelling the ever-increasing heat, which by this time threatened to put a stop to our progress. We had feared that this internal heat of the earth would be too intense for us, and in preparation had gathered such information as was available about it. The 1926 year book of the *Encyclopedia Britannica* says that coal mining is being carried on in Belgium at a depth of 4,000 feet; and the mining of minerals to a depth of 6,000 feet in Brazil.

The subject of limitation of possible depth of working has been very carefully studied in Belgium by Professor Simon Stassart of Mons, in *Les Conditions d' Exploitation a grands Profondeur en Belgique*, he points out that no special difficulty has been met with in workings more than 1,100 meters deep, from increased temperature or atmospheric pressure. From data secured in deep mines, he concluded that 1,500 meters would be a possible workable depth. It seems to be the consensus of opinion that the temperature rises about one degree for each one or two hundred feet of depth.

On the other hand, Jones, assistant to the Astronomer Royal of Greenwich, says we have no direct evidence as to the temperature gradient at great depths.

No doubt the fact that the earth's crust had been disturbed at a comparatively recent date was a circumstance in our favor. But we had not been on the way many days when it was borne in on us beyond all argument that the heat was increasing with great rapidity. While former calculations might be grossly inaccurate, they were undoubtedly based on fact. We were obliged to telephone to camp for ever increasing supplies of ice, and the ventilating system had to be speeded up to its utmost capacity. Even then the heat became almost unendurable.

We were now about a mile below the deepest mine. During all this time, we had encountered very little change of soil, except that it had become much more compact. This was due to the increased pressure of the lower levels. We were in the habit of taking samples of the soil at intervals of 12 hours; and these samples were examined very carefully for any signs of the asteroid.

At length we found fragments of what appeared to be cinders from a furnace, and upon analyzing them found them rich in metal. This gave us renewed hope, although we reasoned that they might have been the result of some early volcanic action and not related to our meteor.

Not many hours after finding the cinders, we came upon a large fragment of semi-transparent material, resembling glass. Upon cleaning and examining this, we found to our great astonishment that it contained several short pieces of round metal rods, unmistakably of human design.

What They Found

WE immediately stopped the machinery and proceeded to examine our find with the utmost care. It was an irregularly shaped mass, like a fragment that might be broken off in wrecking a reinforced concrete structure; perhaps six inches in its greatest dimension. It seemed a great deal heavier than the same quantity of glass and iron or copper ought to be. Upon trying to break off a piece for analysis, we found that it possessed a resistance far greater than that of any ordinary glass. And when we tried to melt it in a little electric furnace, we found that the temperature which readily melted glass had no effect on this material. When we tried to saw off the protruding end of one of the small rods, our hack-saw blade would not even penetrate the surface.

This metal was also much more impervious to heat than any metal with which we are familiar. In color and structure it resembled platinum.

After much discussion and speculation, we were unable to decide whether this fragment had originally been part of a structure, or whether, in the heat generated by the fall of the meteor, the glass-like substance had melted and accidentally enveloped the rods. Personally, I was inclined to believe that it was reinforced material used in construction, in the same manner that we reinforce concrete with steel rods; although there seemed to be no system to the arrangement of the rods.

At any rate, this was a find of tremendous importance, and there seemed to be but two possible explanations for the existence of anything of human origin at this great depth. Here we were, down in the bowels of the earth—twice as deep as the deepest known mine—under a country only recently inhabited by civilized man.

There was indeed a bare possibility that this quarter of the globe had been inhabited in prehistoric times, by people who had known the use of glass and metal; and that some earthquake of gigantic proportions had buried this specimen of their handiwork to this great depth. And then there was the other possibility—that one that our hope led us to favor—that this so-called meteor was not a meteor in the sense that we are in the habit of thinking of them. Perhaps we thought it was not a solid mass of rock or metal—but that it had been a miniature world; clothed with soil and water and atmosphere, and inhabited by intelligent beings, and that this was a specimen of their craft. However it might have come here, it was evident that it originated in a civilization other than ours.

Being greatly impressed with the importance of our find, we decided to return to camp, where we might escape the oppressive heat; and where, with minds refreshed, we could determine our future course of action.

As a matter of fact, I think we both secretly doubted our own sanity; having been cooped up there so long, without daylight, under the stress of constant noise of the machinery, and enduring the increasing heat. Certain it is that we felt but one impulse, and that one to get to the surface of the earth. We lost no time in calling up camp and telling them to send the car to bring us.

While we were waiting for the car, we experienced a great deal of anxiety, lest the cable might not be long enough; as we knew that when they sent the car down with the supplies, they had used nearly all the cable on the drums. A new length had been hastily ordered; but of course it would take some days to have it transported to this remote place. We were already devising means for climbing up the shaft to meet the car when, to our great relief, it made its appearance. Immediately we scrambled aboard, and gave the signal to haul away.

We reached the camp in such a state of exhaustion that we could hardly summon energy enough to give directions for sending messages to a few metallurgists and geologists, before we took to our beds for a long sleep.

Upon waking, the next day, we received news that Professor Ricks, of the Bureau of Mines, in company with H. C. Scott, of the Geodetic Survey, were already on their way to our camp, and that news of our find was being received with great interest in all scientific circles.

Mr. Kingston immediately set to work with renewed enthusiasm, arranging our scanty laboratory equipment, in order further to test and analyze the strange materials. But I decided that I needed recreation, and betook myself to the nearest mountain stream to fish for trout.

The trout escaped the hook, however; for I sat down on the bank of the stream and in a moment my immediate surroundings were forgotten; and my thoughts flew away to that other little world, which I now felt sure had come to such a tragic end. What kind of people had they been? Were they really people at all, or were they only superior animals, with entirely different shapes from ours? Why had they fallen into the earth with such terrific force? What further traces of their lives might be left there in those torrid depths, and what ones must have been obliterated by the resistless impact of their descent?

I was still deep in these speculations when the setting sun warned me that it was time to return to camp, fishless, but refreshed.

With the beginning of the next week, the two professors arrived, and immediately set to work to verify our supposition that we had found substances of human manufacture, entirely different from our present-day products: substances with hardness and heat-resisting qualities far greater than those of our somewhat similar-appearing modern substances.

Mr. Scott, after some hesitation, consented to go down to the mole with us, and make a survey of the soil at the end of the shaft. He confirmed our belief that we were encountering debris left in the wake of the sinking body; and expressed the opinion that the mere force of impact of the falling body could not have driven it so far into the earth; but that the falling body had been of much greater density, and that it had gradually sunk into the lighter soil, as a stone will sink into a bin of flaxseed.

He discussed at some length the theory that mountains are caused when a portion of the earth's surface is lighter than its surroundings, and is consequently heaved to a higher altitude in order to equalize the pressure confining the molten mass of the earth's interior.

Although our visitors arrived in a rather skeptical frame of mind, they soon became convinced of the genuineness of our discovery, and took a great interest in the furtherance of our work. They promised their aid in raising more money, for by this time our available funds were sadly depleted.

After a week in camp, we prepared to go on with the shaft, and descended again to the mole, full of hope for early success.

CHAPTER IV

An Obstacle

LITTLE did we know that this was only the beginning of our adventures, and that our weeks underground would stretch out into months; and that our discoveries would far tran-

scend our strangest dreams.

Now we progressed very cautiously, stopping the machine and going forward every hour to examine the soil, and search for foreign deposits.

Presently the cinders and heat-fused rock and metal became more abundant, and by the end of the week we were in the midst of much matter that seemed to belong to the asteroid rather than to the earth. At length we encountered surface soil that resembled our own surface to a marked degree; although it was intermingled with so many cinders and other debris that it was hardly recognizable. Here we halted, and held a "council of war."

It was manifest that, if we had reached the surface of the asteroid, here if anywhere we should find the objects of interest. But how to find them; that was the question. It was impossible to deviate very far from a straight line with the mole, since it had no steering apparatus; and since it was only equipped to manufacture blocks of a regular shape and uniform size. Again, it seemed impractical to dig into the sides by hand, since we had no means of disposing of the excavated material. And to carry it to the surface in the car and dump it would be such a slow and expensive process that only by the rarest streak of luck could we hope to secure any commensurate results.

So, after several telephone consultations with friends and backers on the outside, we decided to establish a way-station and with the help of the car and a few miners, try to make branch tunnels and explore the immediate neighborhood. Later, perhaps we could establish a few more stations at other points, and ascertain if possible the size and interior composition of the asteroid.

But the establishment of a way-station with miners was more easily said than done. When we called Mr. Thomas, who was in charge of the camp, he said he knew just where he could no doubt get two or three men, and he would try to fit them out and send them down the next day. But the next day he phoned and said the men he had in mind would not take the job, and that he now foresaw considerable difficulty in finding anybody who would attempt it.

So we were delayed several days in securing proper equipment, and in searching for competent men to do the work. At length an agent secured two Welshmen, direct from the deep coal mines of Wales, and although we had difficulty in making them understand just what we were mining for, they agreed to take up the work for a bonus of 20% above the prevailing miner's wage. After getting them started, we repaired to the faithful mole, and proceeded to bore a hole in the interior of the asteroid.

From the size of the crater where it entered the mountain, we had estimated that it could not be more than three quarters of a mile in diameter; although it was safe to assume that it might have been somewhat distorted in shape by its long fall. Even so, we hoped to penetrate it in two or three weeks. Here it was very much cooler, for some reason which we were unable to ascertain, and for the first couple of days we made good progress; but then the soil began to grow more solid and dense, and we were hard put to it to make away with all the dirt taken out. Our hole was reduced to as small an opening as would accommodate the mole; and even then we were accumulating a surplus of soil.

At length we had to call for the car, and send a load of it out to the surface. The next day we had to send two loads, and by the end of the week we had the car working nearly all day, and were scarcely able to spare it long enough to do the carrying for the men at the way-station.

About the eighth day, we came upon something so hard and solid that our excavator was unable to make any impression on it; and we turned off the power and went forward to investigate. We found that we were up against what appeared to be a solid wall, almost perpendicular to our tunnel. This wall seemed to be composed of a very hard substance resembling concrete, but slightly transparent, like a crude grade of glass. In fact, it seemed very similar to the fragment we had first found.

At first thought, we were moved to bring out our miners and make an attempt to dig around it far enough to determine what it was. But upon further consideration, we decided that, whatever it was, we could not allow it to block our way; and we decided to make an attempt to blast it out, as we had done with so many boulders.

So we got out the electric drill, and went to work. But the wall seemed harder than the drill, and before I had made half a dozen inches, both the drills I had on hand were worn to mere stubs. So we had to wait in enforced idleness while we sent a hurry-up call to camp for new drills, which did not arrive for more than two hours.

Then we made a renewed attack, and after using up two more drills, decided to try a blast, although our hole was only fourteen inches deep. We tamped in a heavy charge of black powder, and set it off.

What was our surprise to hear only a weak, muffled explosion; and to find on returning that our tamping was still there, and that the hole was tightly closed. What else could have happened, than that the blast had broken through on the opposite side? In that case, there must be an open space on that side. We were thrilled by the prospect; for here at last was a chance of learning something of the life and activities of the erstwhile inhabitants.

We put in a call for more drill-points, and set to work to sharpen and temper the longest one we had left. This time we planned to plant a number of shallow blasts in a circle around the original

hole, hoping to dislodge a large enough fragment to allow us to pass through.

This time we succeeded in blowing a hole a little larger than a barrel-head; but, to our consternation, we found a reinforcing rod nearly through the center of it.

With a pocket flashlight we proceeded to examine the cavity beyond. It was evidently a very roomy place, and the feeble ray of the flashlight revealed only space. So we rigged up a searchlight out of a piece of sheet metal and a hand glass we happened to have in the mole. Fortunately, we had brought a high power bulb to use on our extension cord. Meanwhile, we called up for an acetylene tank and torch, with which to burn the reinforcing rod away.

What They Found

AS soon as we had the searchlight made, we inserted it in the hole, and surveyed the vast interior of the place. For it was surely very roomy; a huge cavity, perhaps twenty-five feet across, and stretching away to right and left, above and below, as far as our light could penetrate. Here and there were column-like struts across the cavity.

We agreed that it must be some extensive engineering project. It resembled the interior of some great power dam, or possibly a storage reservoir, built in connection with filter beds for water supply.

About this time our torch arrived, and we proceeded to burn the rod out. As we had more than half expected, it resisted the heat surprisingly. In fact it was necessary to turn the flame on full blast, and burn in one spot for nearly five minutes, before it gave way; although the rod was less than an inch in diameter.

Now at last we were free to enter the strange place; but it dawned upon us that we had been at work for over twelve hours, only stopping a couple of times to snatch a bite of food. Our eagerness and excitement had carried us on to the point of exhaustion. Without washing or undressing, we literally fell on our cots, and slept for ten or twelve hours.

After breakfast next morning (shall I say morning? There was nothing to indicate whether it was morning or evening and we had become so engrossed with our work that we had lost track of the days), we decided to go to camp and recuperate for a day or two, and return with ropes, extension cords, and such other equipment as we could scare up, and put on an exploring act.

This we did. Our stay at camp was necessarily longer than we had planned, because we were obliged to send a man to the railroad station to order a large quantity of extension cord from the city, and wait for it to come by express. This took nearly a week; so that we had become quite used to sunlight and the regular succession of days and nights, before we were ready to descend again into the bowels of the earth, and as Mr. Kingston put it, "make monkeys of ourselves."

When we did return with half a mile of cord and a couple of good spot lights, several hundred feet of rope, gas masks, knapsacks packed with emergency rations, and many pairs of strong gloves, we felt like well-equipped Mammoth Cave explorers.

First, we erected a permanent light of high candlepower above the hole in the wall, within the cavity. Then we decided to leave a rope always behind us, leading to the opening; so that if anything should happen to the lights or to our extension cords, we could always find the way back. We had no desire to get lost in this apparently endless chasm. We made fast our guide rope, and coiled it where we could easily put it through the hole when needed. Each one fastened a spot light to his belt, we donned our gloves and knapsacks, and prepared to enter the unknown.

We found there was one of the large struts projecting across the chasm, almost directly below the entrance; and we decided to start operations by descending to this. We were still at a loss to understand the purpose of these columns. They resembled the supporting posts of a large building, except that they were much more massive, and were in a horizontal instead of a vertical position. We finally concluded that they must have been vertical originally, but that the whole structure was no longer in its natural position. We speculated on which must have been the floor, and which the ceiling; and we strained our eyes for some sign of stairs or doorway. We could see none. After tying a number of knots in the rope to make it easy to climb, I lowered myself into the abyss; and after after a few swings, found secure footing on the strut, and my partner followed.

Having reached our first objective safely, we proceeded to plan further "monkey business." By the aid of our lights, we could make out other columns beneath us, and we decided to make another descent. This accomplished without mishap, we determined to make yet a third, and then return to the mole and call it a day. The columns were perhaps sixty feet apart, and this brought us to about a hundred and fifty feet from the entrance. We judged this would be a fairly stiff climb for the first day, and we didn't want to lame ourselves at the start; and, besides, we had a feeling that we would like to be out of there.

It was while we were exploring from our third and last position, that I discovered that the walls were slightly curved; at least they appeared to be. The side we were on being slightly concave, and the opposite one convex, and parallel to it. We thought it strange we had not noticed this before, and wondered what it could mean.

It was from this point that we also thought we saw a narrow ledge along the wall, far beneath us, extending away in both directions. It was so far away that our lights were not strong enough to

bring it out clearly, and we were not sure that it was not a shadow, or merely a discoloration of the wall. We decided to make this our objective on the morrow, and started to make our climb back to headquarters. It proved something of an ordeal, and we were glad enough to rest when we got back.

On retiring, we lay awake for hours, speculating on what this structure could have been used for. It was entirely empty, and showed no signs of having been inhabited, or used for anything. We argued that these people could have had no use for a power dam, and we could not conceive of any use they might have had for such a large storage tank. And besides, there was no sign of any water or other matter having been present. We did, however, arrive at the conclusion that the curvature we had noticed probably corresponded with the curvature of the asteroid's surface.

The following morning we approached our task with a little more assurance, and descended to our former furtheat point quite briskly. We immediately began to consider how most advantageously to reach the narrow ledge, if ledge it was, that we had sighted the night before.

We first lowered a light nearly down to it, and it was revealed as a real continuous ledge. It was, however, so very narrow that we were in doubt as to whether it would be possible to walk along it. But we did succeed in reaching it. It was apparently about a hundred feet below us, too far to climb a rope, we thought; so at Mr. Kingston's suggestion, we made a rope ladder. This was a rather lavish use of our somewhat limited supply of half-inch rope, but it seemed the only safe way.

By noon, we had the ladder done and securely fastened by means of slings to the column where we were working, and I started the long descent. I found it a hazardous and wearisome climb, because the bottom end was loose, and allowed the ladder to swing and kink and tangle up below me. I was swung back and forth like a pendulum; but I finally reached the ledge, and found to my relief that it was wide enough to stand on, if one stood very straight.

There was nothing available to which I could tie the ladder, so I stretched it as tight as I could, and stood on the side ropes, so that my partner could come down with greater ease. After passing our lead rope and also our extension cords through the bottom of the ladder, we started to make our way with great difficulty along the ledge.

The ladder was now a thing of supreme importance, and we most emphatically didn't want to lose it. We would have been entirely out of luck had anything happened to that ladder, or if we should have lost our bearings, and be unable to find them.

We progressed very slowly and cautiously, testing the strength of the ledge at every step; in constant fear that it might crumble and give way, plunging us into unknown depths below. This ledge was not level with respect to its course along the wall, but ran at an incline of what seemed to be about 10 or 12 degrees.

CHAPTER V

Closer to the Secret

UPON leaving our landing place, we started in the direction of its descent; because we figured that if the main wall continued to curve inward, as it seemed to be doing, it would gradually approach the horizontal; and the ledge would become increasingly easy to walk on as the wall deviated more and more from the perpendicular.

We had laid out coils of our lead rope and extension cords, containing about 500 feet, and presently they became so hard to pull that we judged we had come to the end of them, and were now pulling from the main coils. So we determined to retrace our steps and call it another day.

Before going to bed, we arranged new and longer coils of lead rope and extension cord, in such a manner that we hoped to be able to progress, if necessary, about a quarter of a mile. We also put a small drill, a hammer and some small iron pipes in our knapsacks, so that we could fasten our ladder securely to the ledge. We decided to take the electric grill, to make coffee on, and to carry two days' rations.

We called the camp and advised them that we would be off on a two days' march; and told them, whatever they did, not to turn off the electric current.

At five o'clock in the morning we began our trek, and by nine-thirty we had progressed, as nearly as we could estimate, a thousand feet along the ledge. We found, as we had hoped, that we were approaching the bottom of the curved cavity. However, our lines were becoming so long that it was very heavy work pulling them; so we halted to rest, and incidentally to eat a hot lunch. Here we rested a couple of hours, and then, after pulling out some two hundred feet of slack on our lines, proceeded less laboriously along the ledge, for it was no longer steep enough to be dangerous, even if we should lose our footing.

Presently we were surprised to find ourselves directly in front of a hitherto unnoticed opening in the wall, floored and arched like a great hall, and leading back at right angles to our course, as far as our lights could penetrate. We, of course, had no idea where it might lead, but we decided to investigate. But as our lines had grown so heavy to pull by this time, we thought it well to mount our lights at the entrance, and go on with our battery flashlights; because so long as the hall did not branch off, and so long as we kept within sight of the stationary lights, there was little danger of our getting lost.

Very slowly and cautiously we went on, flashing our lights on the floor, walls and ceiling, and watching for pitfalls. Our progress was rendered more

difficult by the fact that the hall was tipped up on edge, at an angle of about 15°, tilting the floor so far out of level that it was difficult to keep our footing. It also slanted down longitudinally on a grade of 10 or 12°. This of course was due to the fact that the force of gravity within the earth was so much greater than that of the asteroid, that a new center of gravity had been formed as soon as the tiny planet came in contact with our great mass.

Things that had been orderly were naturally all topsy-turvy now. At the end of about a hundred yards, we came upon a huge door that had broken from its fastenings, and fallen at a crazy angle across the opening. After some little difficulty in crawling past this, we came upon a large room. How large it was, we were unable to determine, since our flashlights gave such a limited ray, and we were determined not to go out of sight of our lights in the rear.

We could see, however, that the room was not empty, but was filled with furniture of a sort and showed signs of human occupancy. With no little effort we overcame our curiosity, and returned to our lights and lead rope, where we made our supper; after which we lay down in the end of the hall, and in spite of our necessarily uncomfortable attitudes, took a short nap, for we were both dog-tired.

We were, however, too nervous and excited to sleep long; knowing as we did, that we were on the verge of a very momentous discovery. So, after a few hours of inactivity, although not much refreshed, we started in to pull our lead rope and extension cords as far into the hall as we could. We planned that after we had used up all the stock we had provided, we would return to the mole, and let more slack into the vault. Then we would make all preparations for another expedition, and then take a good night's sleep.

Our long climb back to the mole seemed all the more tedious, because of our impatience to get on with our explorations. In the morning—if one could say there was any morning in this eternal darkness—we armed ourselves with goodly stores of provisions, and two high-powered light bulbs, and hastened back to see what was in our newly discovered room.

Yes, there was no doubt; it was furniture, tables, chairs, wall cases, shelves and a great many other things that we did not at first recognize. Fortunately, all this was securely fastened to the floor and walls, otherwise it would have been in a great heap in the lower corner of the room. For this room was, of course, on a plane with the hall.

It was indeed a big room, as large as a modern convention hall. We brought in our rope and wire, and after suspending our lights from some of the highest shelves, set to work in earnest to explore this treasure house.

It seemed to be a cross between a library and a museum. One large apartment, set off from the rest by a low lattice partition, was filled with maps and photographs. Another department was all books, or at least they appeared to be similar to our books. The printing was on very thin sheets of what seemed to be white metal. It could be torn, but not so easily as paper. This was rolled on two rollers, fastened some six inches apart, so as to give a flat surface for easy reading. As one roller unrolled, the other rolled up, like film in a kodak.

This seemed to be a very compact arrangement, taking much less room than ordinary cover-bound books. Of course we were unable to read any of the text, as the characters were entirely strange to us. But I will return to this subject later.

Then there were departments filled with machinery, laboratory equipment, mineral specimens, and building material. There were models of animals and fish; manufactured articles, and fully as many other things, concerning whose uses we could form no conception.

One thing was strikingly evident. They had taken every precaution to preserve everything against the ravages of time. Everything was coated with a kind of transparent shellac, or was in some way sealed from the action of the atmosphere. But in spite of all precaution, some things were beginning to decompose; and all was covered with dust, and was grimy with age.

There were so many totally unfamiliar objects to be examined, that it was like attending an exposition in a foreign land. In this case, however, we were the only visitors, and we were far from being in holiday attire. We were dusty, dirty and dishevelled from our long climb. But what we lacked in personal appearance, we made up in interest and enthusiasm. Needless to say, our nerves and brains were in a highly wrought up condition. Surely, this was no common experience. After months of incessant labor, after burrowing like animals and braving every danger, at last we had reached our goal. Here we were, in the very midst of another world; surrounded by a multitude of things no earthly eye had ever seen.

A Strange Language

WE knew not when we might uncover secrets of inestimable value to mankind, or at what moment we might encounter an engine of destruction, ready to annihilate us.

So frenzied now with eagerness, and frozen now with fear, we went from wonder to wonder, seeing but only half believing; awake, but experiencing all the sensations of an amazing dream. We soon realized that we were going to be able to do no more than scratch the surface at one visit; so we put in the major part of our time in the department of pictures and photographs, for here we could read without knowing the language, and here it seemed we could glean the most knowledge with the least

effort. We were especially anxious to learn what kind of people had inhabited this mere speck of a world, and how they had lived.

From the pictures, it was evident that they did not differ greatly from ourselves; except of course they did not dress as we, and they were pictured in altogether strange environment. We both expected to find they were very small in stature, but there appeared no proof of this.

Of course it was difficult to judge from the pictures, because we could establish no certain standard of measurement; since everything pictured was strange to us. In fact we had no way of arriving at the actual size of anything, until we found one or two objects that were pictured the same as we now saw them in the museum. (By common consent we were calling this place a museum, for want of a more expressive name).

The furniture here—the chairs, tables and so forth—seemed to be about earthly size; and the books, implements and the like seemed to indicate that these people had about the same spread of hand as we have.

We had been some hours submerged—for submerged we literally were in this sea of strangeness—when we noticed that there were several hands in various places, all pointing in one direction. At first we paid little attention to this, thinking it might indicate an exit, or the custodian's office, or some like convenience.

At length, after noticing quite a number of them, we decided to follow up and see what was meant. We found that they led back to the book department and here, in the book department, was another hand that pointed to a little table in a corner. On this was a glass case, very carefully sealed, and containing three small roll books. The case seemed to have no door or opening of any kind, and the material was so tough that it was with the greatest difficulty we were able to break it. We pounced eagerly upon the books, and it only took a moment to discover what the first one was. It was unmistakably a primer and key to the language.

Here was positive proof that things had been arranged for our benefit; that is to say, for whoever might find these things, and who would naturally want to be able to read their language. The first pages were devoted to what we at once recognized as their alphabet.

There was a picture of the organs of speech—lips, tongue and teeth, etc.—showing how the sounds were produced; and under it the character representing the sound. If the tongue and lips assumed more than one position, as in our letter B, all the positions were faithfully indicated. I had never realized until that moment, what a purely mechanical process talking is. Here were 28 characters, representing as many sounds, and full instructions how to speak each one. Practically all the sounds of which the human voice is capable seemed to be represented, for neither of us was able to produce a syllable that was not depicted.

The next few pages were devoted to names and pictures of familiar objects; supposedly familiar, but alas! few of them were familiar to our eyes. It was, however, interesting to know what they called the strange objects shown.

Here was the situation in a nutshell. These people had foreseen, or at least recognized the danger of their extinction; and had made these elaborate preparations in order that the progress made by their civilization might not be wholly lost. We could not help thinking how narrowly it had escaped being lost, even at that; and we thought how marvelous it was that we should be the favored ones to find these results of such prodigious labors.

But if they had been to such pains to reach us, it was evident that we must now reciprocate, and expend a great deal of labor in order to profit fully by their gift.

By this time we were in need of supplies and proper rest, and we deemed it best to take these few books back to the mole, where we could have leisure to study them, and opportunity to use a phone.

Needless to say, we were fairly bursting with eagerness, if I may use a common idiom, to "tell the world" of our success. Safely back to the mole once more, we decided that we must establish better communication with the museum, and also get some help to carry on. We were resolved that nothing should be removed till all had been inspected and tabulated. Mr. Kingston thought it might be possible to reconstruct the room with all its contents, just as we found them.

We asked Mr. Thomas, camp superintendent, to procure a quantity of lumber with which to build hanging walks and ladders; and to engage a gang of riggers and carpenters to send down. We also asked him to send a photographer with a large supply of films and flashes.

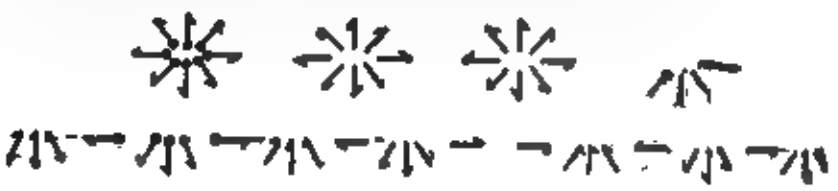
Then we wired to the various institutions that were interested in the expedition, asking them to send us language experts, archeologists, and whatever research workers were available. Mr. Thomas came down to take charge of our rigging work, leaving the camp in care of an assistant, and bringing with him the photographer, who was an athletic young man, and who had no difficulty in getting down to the museum and taking some pictures.

After showing the superintendent what needed to be done, we went up to camp, and set up a primary school. There were but two pupils, both for the first grade work; and it was their first concern to learn the alphabet, and perhaps how to read a few numbers.

Pending the arrival of more help, we gave our entire attention to this work; working all day, and only snatching time for meals and necessary exercise. The alphabet was very simple as compared with ours, and very little skill was required in forming the characters. We found there were only

four characters; or to be more precise, one character with three variations of form. These in various positions represented, as I have said, 28 sounds.

The forms and positions were represented in this manner:



It will be seen from the lower figure that the position was horizontal, perpendicular, at an angle of 45°, there being therefore eight primary positions as the spokes of a wheel.

Written in line, they appeared as shown above:

We first learned to spell a word that indicated a hand,—finally by the end of the fourth day, we were reading aloud to each other, with very improper accent no doubt, such simple exercises as, "The man took a drink of water," or "I want to go home."

CHAPTER VI

The History of Vallenna

OF course we were frightfully handicapped by not having an inter-language dictionary. We were obliged to refer so constantly to the illustrations that we had little opportunity for other study; and in a great many cases, these illustrations meant very little to us when we did find them; owing to the fact that the objects themselves were new and strange to us. We found that their numerals also were of a very simple design, and that their methods of computation were not greatly unlike ours; and we quite readily learned to read and write numbers.

The last sentence in the primer said: "This is the world of a hundred men; we call it Vallenna." And so, for purposes of this report, and perhaps forever, it shall continue to be called Vallenna.

By the time we had finished the first book, and had its lessons fairly well in hand, experts and assistants began to arrive; and we were obliged to enlarge our school. We now had to divide our time between teaching what we already knew, and delving deeper into more advanced knowledge. Whenever there was a new arrival, one of us would play host and guide, and take him down to the museum, in case he was athletic and adventurous enough to make the trip. Seeing things at first hand in this manner served to convince one of the importance of the work, and whet his interest to a keen edge. The trips also afforded opportunities to bring up more advanced books or pictures, and occasionally some other small object that we thought might help us in our studies. We reasoned that it was of little use to allow any of our assistants to attempt any research work in the museum until they were fairly conversant with the language; except that we encouraged electricians and mechanical experts to inspect the place, to see if they could discover any signs of electrical devices, or other scientific appliances, or any substitute for these.

Although it was self-evident that there must have been some facilities for illuminating this vast subterranean place; yet, up to the time of writing this report, we have not discovered any such devices.

Meanwhile the work of constructing ladders and walks was progressing quite rapidly. By the end of the fourth week, our camp had grown to a little colony; and our progress was such that we felt sufficiently equipped to take up the Vallennian's history. The text books told us that a set of volumes had been prepared for us, and deposited in an especially safe place.

Following the directions, we secured the first volumes, and started to translate them into English. We divided our forces into pairs, each couple taking a chapter and giving their entire attention to it. And here began to unroll a tale such as no man ever read before; and one that I believe will remain unique for all time.

Like that of our own race, their early history consisted largely of folk-lore and mythology; but their oldest authentic writings were dated six hundred and sixty thousand years before the opening of the ice age. I mention the ice age, because it is very plainly indicated on their astronomical photographs; and this date, in connection with two or three others that I plan to discuss later, were the mile-stones which enabled us to arrive at their method of computing time. Their history went back so far, indicating a career of such unbelievable duration, that we were very reluctant to accept it. But after several students had made the translation and separately computed the time in our years, we were compelled to consider it authentic. For about the first two hundred thousand years, there is just here and there a date at widely separated intervals; but about four hundred thousand years ago, the history becomes quite consecutive, and, with the exception of a couple of short gaps, is continuous. Therefore, in this necessarily brief account, I cannot do more than touch on the more important happenings.

Perhaps the first thing that particularly interested us, was that at about the time of our third glacial period (third from the last), they invented telescopic photography; and at periods, roughly speaking, fifty years apart, their path in space had brought them near enough to the earth to take pictures. Reprints of a great many of these photographs were found to be on file, in a fairly good state of preservation. In fact, there was a continuous series of pictures, continuing down to approximately 5000 B. C. of own era. These photographs, besides being of great value in helping to understand their history, will shed a great deal of light on the various geological changes that have taken place here on earth.

So their history progresses, century after century,

dealing largely with their changes of government and the evolution of their religion; with, here and there, a biography of someone of outstanding ability.

Their religion, in the beginning, was very primitive; and consisted of superstitions about various natural phenomena. But it finally developed into what seemed to have been a very enlightened and advanced form of worship.

Several times they were nearly wiped out by famine or other disaster; and for a great many thousand years their progress was seriously retarded and hampered by over-population. I will return to this phase of their lives later.

They developed early a very complete knowledge of astronomy, and apparently had telescopes and photographing facilities a great many thousand years ago, that were equal to or better than our best at the present time. And it is largely because of their knowledge and use of these things that we have any detailed information of their lives today.

One Hundred Men

WE are told that this little planet had a diameter of 5360 feet at the equator; scarcely more than a mile. Through the poles it appears to have been about a hundred feet less. The poles pointed approximately to the same point in the heavens that the earth's poles do. This caused an inclination of the plane of their orbit of about 21½ degrees. Their orbit around the sun being a great deal larger than ours, they made the journey in about 9½ years of our time, and the planet revolved on its axis in seven and a quarter hours. In a general way, their surface was composed of hills and valleys as ours is, but they were of course so small as to make very little difference of temperature. However, the poles of Vallenna were very cold, and the equatorial regions very hot.

There was a miniature ocean, covering nearly half of the surface, the main body covering most of one side; and broad arms meeting each other along the equator, somewhat resembling a shallow basket with a wide handle. This handle divided the land into about two equal continents, known as Mall and Yemp. They called the water area The Gult. In some places the Gult attained a depth of 120 feet, and it contained four or five small islands.

So they had a little less than a thousand acres of ground, the major portion of which was covered with the rich black soil that Mr. Kingston had discovered in his laboratory work. A great deal of this soil had no doubt been moved from one place to another, in order to fertilize districts that had originally been barren.

During the long summer, which extended over four and a half of our years, most of the land received enough of the sun's rays to produce crops, but the polar regions were too cold to produce vegetable growth. In fact they were covered with snow and ice.

These long seasons enabled the Vallenians to literally transport their farms from a winter to a summer climate. When winter approached in the northern hemisphere, they gathered up their topsoil with the help of huge power scoops, and loaded it on barges and shipped it over to the southern hemisphere, where it was springtime, and set it to work anew.

We know nothing definite as to the origin of these people, but at the time of their first mentioned census, there were some sixty of all ages. These gradually increased for a long period of years, several centuries in fact, until there were nearly two hundred; which was a great many more than it was possible to provide with an adequate supply of food. There followed a long, long period of poverty and want, when every effort was put forth to produce more food.

During these centuries the inhabitants deteriorated, both mentally and physically; and dates of historical interest were few and far between.

In these days of desperate effort to survive, many of their arts and inventions were lost, either wholly or in part. Then came a great pestilence, and a merciful Providence wiped out all but about fifty.

This was, I suppose, a case of the survival of the fittest; and no doubt left a strong and superior stock. These, relieved of the necessity for intensive cultivation, and with proper nourishment, and leisure for development, took up anew the arts and sciences. They recovered some that were lost, and developed others that were new. They dug into the hills, and discovered new mines. They invented new machines, and in a general way advanced what we call civilization. This went on apace for a few centuries, until over-population again stared them in the face.

And so it went on; history repeating itself through many cycles, until finally there arose a great man—one Yambold—who became and ever remained the world hero of Vallenna. This man conceived the idea of compulsory population control; and his courage and force of character were so great that in the face of all religious and superstitious prejudice, he set to work to frame legislation and iron-clad rules to arrest the growth of population.

It happened that at that time there were about 100 people on Vallenna, and Yambold proclaimed the slogan of "The World of a Hundred Men." He was successful in convincing a majority of the people that herein was their emancipation from poverty and periodic famine. And The World of a Hundred Men it became, and remained from that remote time to the end of their history.

In the ages that followed the life of Yambold, there were a number of discoveries that were of great benefit to agriculture. Species of fruits and vegetables were enlarged and improved, by methods not unlike those of our late Mr. Burbank. New deposits of chemical fertilizer were discovered

in the ground, and a method of taking nitrogen from the air was perfected. All this, together with the construction of large green-houses, so increased the production possibilities that the population quota could be safely raised. So it was decided that thereafter only the males should be counted as a basis for making up the quota at the beginning of each period; and the slogan of a hundred men came to mean not a hundred people, but a hundred males.

The Vallennians very early became acquainted with the use of various metals, and carried on extensive mining operations. Gradually they improved their methods and machinery, and drove their shafts deeper and deeper, until finally, in one of their deepest mines, they came in contact with a huge mass of metal. This metal was very heavy, and harder by far than anything as yet discovered.

They proceeded to take out large quantities of this metal, and found it very useful. Now, long after, the same metal was found at the bottom of another very deep mine, and as time passed it was found that whenever a shaft was sunk to a great depth, the same solid mass was encountered.

Investigation revealed that the several points of encountering the metal were at practically a uniform distance from the surface. Hence it was concluded that there was probably an immense deposit of it, constituting the whole interior of Vallenna; or as we would say, the earth. This thought was, on the whole, rather encouraging; for by this time they were using the metal so extensively that it formed the backbone of their industry.

As their scientific researches became more advanced, they decided to try to learn what it was that attracted the magnetic needle in their compass. For there, the same as here on earth, there seemed to be something some distance from the north pole that governed the direction of the needle. Having located the spot on the surface as closely as possible, they set to work, at great labor and expense, to sink a huge shaft.

Here, the same as elsewhere, they came upon the metal deposit; but a little nearer to the surface than in the mines closer to the equator. They found that this metal, although differing only slightly from the other in composition, was about 91% iron and 9% nickel. It was very highly magnetized; in fact more so than if treated by the most advanced methods for artificial magnetizing.

Branch shafts and tunnels revealed the fact that there was quite a large area affected, that is magnetized, perhaps a couple of acres.

CHAPTER VII

A Daring Project

NOT many years after this, it was decided that the government should assist scientists in an attempt to ascertain the size and shape of the great core; and it was decreed that all removal of metal should be placed under government supervision; and that each mine should follow along the surface, taking out a groove in the metal, of uniform depth and width. No metal was to be taken out in any other way.

So much of this metal, which they called *delon*, was being used, that not many centuries had passed until there was one channel cut all the way around. Several others were cut a large part of the way, in the general direction of the equator; and one or two had progressed quite a long distance in a longitudinal direction. (As you must know, centuries with them were no more regarded than years are with us; for their span of history was infinitely longer than ours, and it was an age-old habit with them to plan for coming generations.)

By careful measurements it was determined that this core was very nearly a perfect sphere; and that it occupied slightly more than one-third of the interior of the asteroid. From data thus arrived at, scientists ultimately evolved the theory that it was this core, spinning, with its great weight and density, that caused the daily revolutions of their tiny world; and that the lode of magnetized metal near the north pole was acted upon by some unseen body in the far northern heavens; and that this governed and stabilized the direction of the axis. By the same reasoning, it was this central core that had originally been started in flight or its orbit around the sun; and the soil and outer layers of the miniature planet only followed because they adhered to the governing core.

For ever so many generations no attempt was made to put this thory to any practical use. Then there came a man who was a profound student of the various sciences, but who was too much of a dreamer to make any substantial progress in scientific work. This man finally withdrew from scientific work, and became a fiction writer. His work in this line was very successful, and he soon won fame. His fiction, however, was always semi-scientific in nature; and it was recorded that through his fiction, which was very easy to read, he taught more science, to a larger class of people, than ever the schools did.

Be that as it may, he at length wrote a very fanciful book, in which he discussed a plan to free the rest of the planet from its governing core, and install mechanism to regulate the length of the days. In this book he argued so convincingly, and all his contentions were so truthfully based on hard facts, that there was no denying the possibility of the scheme.

Historians came to believe that he only appeared to withdraw from scientific work, in order to present this proposition to his little world; knowing well that if he tried to suggest any such undertaking seriously, he would be laughed at for a lunatic, and forgotten as soon as he was dead.

His book, however, was so cleverly written, and was such a gem of literature, that it kept on growing in popularity long after he had passed on. His

theory, as time progressed, became common knowledge; and without any definite action being taken, it finally came to be accepted as a matter of course that some time this work would be accomplished.

Meanwhile, the mining had continued under governmental supervision, and large surfaces of metal had been exposed. The writer had pointed out what a great benefit it would be to their race if the days could be lengthened to about 12 or 14 hours, and the nights to about eight; how the increased sunlight would increase agricultural production, and give a more suitable length of time for a day's work and a night's rest.

The plan was to let the world spin rapidly when the ocean side was toward the sun, and very much more slowly when the land side was toward it. A sort of "sunlight saving" scheme. Finally the preliminary work had progressed so far, and there had been so much discussion, that it was decided to take a vote as to whether or not engineers should be appointed to work out practical plans, and submit estimates of the probable cost of the undertaking.

A meeting was held at which the people gathered to discuss the project, and the majority voted for the great scheme. Their history records that the work was undertaken, and ultimately carried to completion. In the plan room, we found detailed engineers' plans of the completed work; a work that required over twenty centuries of almost continuous effort; but which can be described, in a general way, in a very few minutes.

In the first place, they removed the soil, which was very largely limestone, from the surface of the nickel-iron core; building as they did so a substantial reinforced glass cover or wall, some thirty feet from the core.

This was the wall we had come upon, when digging with the mole. The huge columns or struts were built of the smelted nickel-iron, or delon, reaching to within a foot or so of the core; and in the ends of these struts were fixed round balls, somewhat after the fashion of a ball-bearing. These could play back and forth for a few inches, thus holding the core in place.

The core proved to be very nearly a perfect sphere. However, there were a few slight irregularities, and these had to be smoothed out, to provide an even surface for these balls to travel on. And this, to my way of thinking, was the greatest engineering feat of the whole process.

Think of the infinite care, and the delicacy of instruments that it must have required, to gauge a ball from the outside, nearly a third of a mile in diameter, so accurately that there would not be an error of more than a foot!

Had we crossed over on one of these struts when we first discovered them, we would have found the bearing; and perhaps recognized that the wall was metal, and this would have helped us to solve the riddle.

At each pole, a certain area was left unexcavated, until after the governing machinery was installed. This machinery was quite simple, but very ingenious. A huge quantity of magnetized metal was taken from the so-called magnetic pole, to which I have alluded.

This metal was cast in sections, forming a great ring encircling the equator of the core. These sections were geared to vast bulkheads, made of the same material as the walls. Their name for this material we translated "Concrete glass." Then huge motors were installed, to raise and lower these magnetic ring sections.

When the ring came in contact with the core, its magnetism was such that the core was gripped with sufficient force to carry all with it. But when they were withdrawn, the core was free to move without the shell; and the shell remained stationary, or nearly so.

Then the soil was removed from the region of the Poles. When all was in readiness, the great motors at the equator were set in motion, each having been tested separately to make sure it was capable of raising its section of the ring. And as the space between the magnets and the core slowly widened, the core began to slip by; very slowly at first, but with constantly accelerated motion.

It Works!

AS soon as the operators were convinced that the test was successful, they allowed the ring to drop back into contact, because they were afraid that if the shell was allowed to lose too much of its momentum, it would be impossible to start it again, and serious damage might result. After several trials, it was found that the speed of the shell could be safely accelerated and retarded at will. However, it was found that even if the magnets were raised as far as possible, the shell did not entirely stop but kept on at about a quarter of its normal speed.

It must be remembered that the surface of the core was not moving at a very rapid rate, as a point on the surface of the asteroid only moved about three miles in seven hours. Whereas a point on the earth's surface at the equator moves at the terrific rate of one thousand miles an hour.

So it was proved without mishap that the rotation mechanism was a success. And very soon it dawned upon them that this revolving core embodied practically inexhaustible stores of power, and they made preparations to harness it. A system of friction-drive generators were installed in such a way that when the shell was retarded, the passing of the core drove the generators; furnishing a cheap power for operating all their machinery.

They had now mastered the situation.

By manipulating the rotary controls they were able to produce a day of any desired length. They could make the day on the land side long, and the night short, or vice versa. In this way, as had been prophesied, they could increase their production of

food-stuffs to a very large extent. So it was found possible to raise the population limit after a few years, and they accordingly raised it to a hundred adult men, instead of a hundred males of all ages, as heretofore.

This increased the population about 40 per cent, but it made more applicable the slogan, The World of a Hundred Men. And they no doubt considered themselves a hundred super-men after this great feat was performed.

Some parts of the machinery we found intact, and the walls and columns seemed to be quite unbroken, except on the lower side where they were a hopeless mass of wreckage. There is so much of interest in the history and accomplishments of the Vallennians that I will not attempt any comprehensive narrative here. But I cannot refrain from touching briefly on their activities in relation to the history of the earth.

From our hasty examination of their records and photographs, we are convinced that a great many changes on the earth that have always been shrouded in mystery can now be cleared up. It is very much like an old neighbor, coming in and telling you how your house was built, long years before you were born.

The earliest photographs of the earth are rather dim and indistinct; the most surprising detail being that so much of the surface is water, and so little is land. Of course, the explanation of this is that in the beginning, when the earth first commenced to cool off, it was naturally in the form of a perfect sphere. Both liquids and gases always assume this shape, when in rapid motion through space. Even rain drops take this familiar form.

At that early time, the hills and valleys were unformed, and a very little water could cover a large surface. But when the earth's surface commenced to wrinkle with age, the tops of some of these wrinkles emerged, and the water receded into the sunken areas.

These earliest photographs show only traces of continents and islands, which meant little to our unaccustomed eyes. The more so, since the earth was not always photographed from the same position.

This last difficulty was somewhat obviated in the later pictures, since the Vallennians formed the habit of taking them in a series of four at a time, at intervals of about six hours. This gave us an opportunity to compare the same faces, and note the changes.

Quite early in our researches, we decided to arrange the photographs in long rows, commencing with the latest; so that we were able to trace the changes backward, from the present in a continuous series.

The latest series showed everything approximately as it was thousands of years ago—corresponding to 5000 B. C. We had an opportunity to observe the continuity of change for a great many centuries.

The first permanent show of land of any appreciable area seemed to be what afterwards developed into Central Europe; and at about the same time appeared a little island, over to the northwest; probably Scotland and part of Wales. These were evidently on the opposite side of the globe from the first land, because none of the latter showed in these photos.

These islands gradually became thicker and larger, and finally developed into an almost continuous stretch of land, corresponding in contour to our present range of mountains, known in North America as the Rockies, and in South America as the Andes.

Previously halfway between these two lands, appeared the eastern portion of North America, or the Appalachian system. And the mountains that now form Spain began to emerge, while new land began to show east of the European nucleus. In due time, the continents of Africa and Australia appeared, and even Greenland was discernible. At this comparatively late date the peaks of the Himalayas began to show above the surface of the sea, and rose very rapidly until they constituted the highest portion of the earth's surface.

CHAPTER VII

What the Pictures Told

As time went on, the various land formations began to assume familiar shapes; and at a time about 380,000 years ago, were somewhat as they are now. But to our wonderment, things did not stop there, but went right on changing. Everywhere new land was arising and the ocean receding, until more than two-thirds of the surface was high and dry. All the district north of Europe, now the British Isles and the North and Irish Seas, and the English Channel, was one with Europe. The islands of Japan became part of the mainland; Cuba and all the West Indies grew and merged until they were one with both American continents.

Asia, Greenland and America also became one in the north. Australia became part of Asia. It was impossible to distinguish Africa from Europe and Asia; while in the Pacific, a great continent rose that included Easter Island, Christmas, the Marquesas, the Low Archipelago, and all that great mass of islands between South America and Australia.

This formation of land was joined in some places by narrow isthmuses to the mainland of Australia and Asia; and on the side toward South America was only separated from that continent by narrow straits, perhaps a few miles wide. Indeed, no one would recognize our good old world from these photographs; and it was hard to believe that the land, once so extensive, could have shrunk to the present areas. Here, then, was the long-sought ex-

planation of the indications that the builders of the stone relics in Great Britain and Easter Island, in the middle of the Pacific, were one and the same race.

There has long been almost conclusive evidence that the people who built Stonehenge and those who erected the Easter Island statues had the same customs and religion. This would also explain why the prehistoric implements found in South America so closely resemble those found in Asia and Africa.

In fact, it was perfectly plain that at one time there was nothing to prevent either men or beasts from roaming the entire world without crossing any large bodies of water. Of course, something of this sort has long been suspected by our geologists and archeologists. But now there happened something that, so far as I know, no scientist has ever suspected; and which clearly explains the glacier periods, and the great submergence, often believed to be only mythology, and which was the foundation for the legends of Sumeria and the lost Atlantis.

One very remarkable photograph showed the earth, and in the near distance another planet, about the size of the earth. This new planet must have passed very near to the earth. In the next picture, taken only a few weeks later, the earth is very much altered, while the new planet has disappeared. Where formerly there was only a small white cap at the North Pole, there now showed a great snow and ice field, extending half way to the equator; and at the South Pole, the erstwhile snow-cap had entirely disappeared.

It was evident that this strange planet had passed so close to the earth that its attraction had altered the inclination of the earth's axis, turning the north polar regions away from the sun. The pictures show that as time passed, this condition gradually righted itself.

For the greater part of a century the snow fields receded very slowly, and at length became fixed in about normal position. We know now, there was a tradition among the Vallennians, that the earth had undergone such a change at least once before, but the One Hundred had not seen what caused it. There could be no doubt that these periods were the ice ages, or glacial periods, so well known to geologists.

When again the strange planet appeared, we had quite a series of pictures; for this was no doubt deemed a very important occasion by the Vallenniana. The first picture showed the earth in the foreground, and the other planet in the far distance. (They had, we gathered, discovered the returning planet with the telescope, when it was still far off.)

In the following pictures, the strange planet, which the One Hundred had long since named the Yudd, appeared to be made up of large areas of land and water, much the same as earth. It approached the earth very closely. And then comes a picture in which the dim outlines of the two planets apparently merged together, were almost obscured, as by a great fog or mist. Then in the last view, the earth is still shrouded in fog, but the Yudd, a little way off, is proceeding on its way, but startlingly changed. The larger portions of its water area have disappeared and in their place the ocean bottom stands out in bare relief.

Pictures of the earth dated years later show very clearly that the land areas are greatly decreased in size, and that the greater portion of the surface is sunken into the sea. The ice area has widened again, as usual. Here, then, right before our astonished eyes, had taken place a great tragedy.

The strange planet must have passed so close that its atmosphere came in contact with that of earth, thus generating an intense heat. This heat caused the oceans of the Yudd to evaporate, and assume the form of rain and mist, which we saw in the photographs.

Then the Yudd, which apparently must have been moving very much faster than the earth, passed on. Most of its water was left behind in the vicinity of the earth. All this water, together with that which had risen from the earth, in due time fell on earth in the form of rain, and practically doubled the ocean area. We know not what dire calamities took place on the drouth-stricken planet Yudd, or whether or not there were any human beings there to be affected.

But there is ample evidence that primitive man already inhabited a number of widely separated districts on the earth's surface; and although they left no legibly written records, we can readily imagine the tragedy that must have taken place.

The Flood

WHOLE continents were suddenly covered with thousands of fathoms of water; only those on the highest mountains escaping death by drowning. In the terrific rains that must have occurred, all the valleys and lower plateaus must have been submerged to a great depth. And added to this, all the northern country suddenly became frigid. So, for the few survivors, it must have been a time of suffering and privation beyond all human conception.

Some fragments of the human family no doubt did survive; although they must have lost every vestige of the civilization that their early works show they had attained. They certainly continue to inhabit all the continents and major islands to this day.

Succeeding photos show the altered land areas nearly as small as now. Although the British Isles were still a part of the mainland, and most of the continents were a little larger than now. Again the historic cycle repeated itself; with the ice fields receding, and, after a great many years, the planet Yudd appearing again. This time there was less

destruction, owing, perhaps, to the fact that Yudd had less water to lose. A great mist cloud was formed, however, and the visiting planet emerged with still more restricted water areas; and when the earth was again clearly visible, it was easy to discern some changes. Of course, it was to be expected that the snow fields would be spreading from the north. But there were also quite a number of changes in ocean and land areas. For instance, the land in what is now the lower Mississippi valley had been submerged, extending the Gulf of Mexico quite a way inland; and the British Isles were parted from the mainland, and where formerly dense forests grew, were the North Sea, Irish Sea and English Channel.

But most noticeable of all was the appearance of the Mediterranean Sea, where formerly there had been only a large lake. This last-mentioned change was perhaps of the greatest consequence to the human family. Scientists are almost unanimous in their belief at this time,—seventy thousand years ago,—according to the records of the One Hundred, this was the most populous portion of the earth; and the region where the race had made the most successful attempt at rudimentary civilization.

This country was south of the periodically frozen regions, and most remote from danger of floods.

Then it must have indeed been a great disaster, when the rain fell in torrents day after day, and the swollen ocean suddenly broke through the mountain barriers at the Straits of Gibraltar.

One can imagine how the raging torrents went roaring through between the Pillars of Hercules; and how, augmented by the rains, the lake became a sea; and how the spreading sea drove people, animals, every living thing before it.

No doubt they climbed the mountains to high points where no flood had ever been known to approach. These mountains gradually became islands, and finally were entirely submerged; with the terrified animals and people all striving desperately to occupy the last remaining pinnacle. And then at the last, men, tigers, elephants and all, swept into the merciless flood. Yes, it must have been an epoch of great disaster to all in that region.

Is it any wonder that the tradition and folk-lore of all ancient peoples contain an account of a universal flood? The story must have been told and retold, generation after generation, in every tribe; until it became known in every Asiatic and European country. We know the Babylonians had a version of it, as did the Arabians, the Hindus, and even the Chinese.

In my own Ridpath's "History of the Chaldeans" whose annals are nearly as old as those of the Egyptians and Chinese, the historian says: "To Berosus we are indebted for what is known as the Chaldean or Babylonian account of the flood. The narrative is full of interest, as tending to show that all the nations having their geographical center in Mesopotamia preserve a common tradition of a great flood of waters by which the country was deluged, and the people destroyed. We know that the Hebraic version found its way, after sixty-eight thousand years, into our Bible; and some, if not all of these versions, are no doubt destined to survive as long as the human race shall endure and inhabit the earth."

We found by reference to the astronomical library in the museum, that this strange planet that returned so regularly, and which the Vallennians had named Yudd, had such a long and eccentric orbit that it passed out of sight in a very few weeks, and could not be seen by the most powerful telescope for more than a few months. Yet it always returned with clock-like regularity, making its appearance on the very day it was due.

We also found explanations of various details shown in the photographs that had puzzled us.

We were interested to learn that the One Hundred Men had been convinced that there was human life on the earth, since about twenty-seven thousand years before the common era. That is to say, they had thought of us as neighbors for some two hundred and seventy centuries.

Even as far back as the building of the Pyramids, they had reflector telescopes so powerful that they were able to observe the progress of the work.

The first proof we have that they were aware of their impending danger, was found in a record of a speech delivered in the legislative assembly, in which the speaker argues in favor of building a memorial structure of such durable stuff that it might not be totally destroyed in case of collision with the earth.

This speech, which is evidently part of a debate, was delivered before they harnessed the planet's core. A part of it follows:

"The solar system, with our sun and the eight great planets, together with the thousand or more asteroids, is constantly changing position. And we know not where it may lead. Throughout all our astronomical history, our orbit has been changing. While we make the same length of journey round the sun, in exactly the same time, yet the plane of our ecliptic is constantly tilting.

"This tilting of our orbit tends to bring us each year nearer to the orbit of the planet Bren (Earth), whose orbit is unchanging. Why we are allowed to wander, no man can say. Perhaps the poor little Vallenna is too small to be any concern to the great Ruler of the Universe. Be that as it may, our destiny seems to be bound up very closely with that of the large planet. Our respective orbits and length of years are such that we pass very close to the earth about every fifth year of our time, and each succeeding time we come a little closer.

"In the dim ages of long ago, the Bren was never seen by day with the naked eye; and by night, only as a round, luminous disk. Only by the use of the strongest telescopes were we able to make out the areas of land and sea. Now, after the passing of a

few hundred centuries, we come so close that it is easily seen by day. Indeed, last year we passed so near that one could easily make out the shapes of continents and the like, without the aid of a glass.

"True, there is no immediate cause for alarm, for no noticeable change is likely to take place in your lifetime, or in mine; and in the meantime, many things may happen to save the day. A great many years ago, there was an incident in the Bren's behavior that leads us to hope the orbit of the earth might still be unchanged.

"Our early records show that the direction of the earth's axis suddenly shifted to such an extent that a great many degrees of latitude in the northern hemisphere were transformed from tropical jungle to frozen ice fields, in a single year.

"Whatever caused this sudden shift is not known; because it happened when Vallenna was at the other side of its orbit. Some of our best authorities believe, however, that some wandering planet came so close that their attraction, acting on the magnetic pole of the earth, caused the shift in the direction of its axis. In that case, this same planet or a kindred one might pass again, and so upset the earth as to draw it out of its orbit, and change its course altogether.

"Although the earth slowly righted itself, as shown by the gradual disappearance of the great snow and ice field, it is evident that some external force is at work with it yet, because its axis is wabbling like a top that has nearly run down; and the star that was their polar star a few hundred years ago is quite a long distance from their present pole-star.

"It is rather reassuring to think that some change may have been fore-ordained; and that the same Hand which placed all these bodies in infinite space is still guarding their destiny, and we shall ride safely through. But while we are unafraid, we know that Nature in her devious ways is no respecter of persons; and every day destruction goes on before our eyes. Big fish eat little fish; plant life must perish to feed animal life; and through destruction of both plant and animal life, we survive.

"Now it is known, according to the law of universal gravitation, that every particle of matter is attracted toward every other particle, with a force varying directly as the product of the masses, and inversely as the square of the distance between them. Now we might easily picture that at some time in the future, our changing orbit would bring us so close to the great Earth, that this attraction would overcome the force of our momentum, and Vallenna would be snatched from its orbit.

"Let us suppose a sudden jerk; a flash of flame; as Vallenna strikes the earth's atmosphere. A long streak of light, giving place to a line of smoke; a tremendous impact! And then poor little Vallenna, buried miles deep in the earth,—a mis-shapen, broken and charred wreck of a once fair world!

"Then I ask you. What would become of my opponent's frail temple, on top of his green hill? Of course we would have passed on, and our labors would be over. But some of our engineering work might conceivably survive the shock, being so well protected. And the earthly inhabitants might find it, and appreciate it; to the end that we might add something to the sum total of human knowledge."

Desperate Efforts

WE find no further reference to this matter until about the time of the formation of the Mediterranean Sea, when a text-book of astronomy was published, containing a computation of the time when Vallenna would probably come in contact with this earth.

This computation was, however, not very accurate, and set the time nearly three thousand years too late. In later text-books and mathematical treatises, however, we found that this estimate had been revised; and a fairly accurate date had been arrived at.

In their latest writings, it was quite generally agreed that not more than two or three times could they come in conjunction with the earth's course, until they would be drawn in by the earth's superior force of gravity.

But as time drew near, decade after decade, and everything continued to point to their ultimate end, they became very much alive to the situation. They made every effort to find some way to change the course of their flight through space, and avert the catastrophe. Records of their schemes to influence their course involved very ingenious plans, but apparently all of them were of no avail.

Somewhere about the beginning of the last century, they conceived the idea of preserving a record of their activities, and specimens of their handiwork for the benefit of earth-dwellers, after their fall.

The accounts of the meetings held to discuss this matter make very interesting reading; and the arguments, both for and against the scheme, were replete with references to astronomy and physics; which show conclusively that they had left no stone unturned in their efforts to master these sciences. I regret that time and space do not permit me to give in detail some of their most striking arguments. But it seemed to be quite generally feared that the Vallenna would be totally annihilated. Or at least, little more than the metal core could survive the heat of the descent and the force of the final impact; and some argued that if any place for storage or exhibit were prepared, it ought to be in the body of the core.

Others were of the opinion that anything in the body of the core would be totally lost, because they doubted if the earth dwellers would be able to excavate in such a hard material.

They of course could not know how far we had progressed in the knowledge of metals; and as this metal is considerably harder than the best grade of armor plate, it is true that we never could have

penetrated it to any considerable depth. Besides, it was not known on which side the core might come to rest.

Again some argued that, since two-thirds of the earth's surface was ocean, the Vallenna would most likely fall into deep water, where it would never be found.

But in spite of the fact that there was very little chance of our finding their work, they decided that they could do no better than to make an attempt; and a committee of three was elected to determine what ought to go into the collection, and where it should be housed.

Resignation

THEY recommended that a small vault of concrete glass be built just outside the wall surrounding the core; and in it should be placed several tons of photographs, books and mechanical devices, representative of their science and art. This report having been accepted, and the recommendations concurred in, they commenced the work of excavating, and building the walls of the vault.

In the meantime, the committee, according to instructions, were considering suggestions from any of the One Hundred, as to any additional things it might be advantageous to deposit.

The suggestions came in thick and fast. Every one seemed ambitious to have everything pertaining to his line of work or his hobby placed in the collection.

So a halt was called on the construction, and new and larger plans were drawn up, and submitted for approval. But by this time the idea had so grown upon the minds of all, that they voted to double the size of the original plans, and try to accommodate every one who wanted to have something preserved. So the work started anew, and an enlarged committee set to work to devise air-tight containers, and various other means of preserving the chosen articles from rust and decay. They evidently realized that the things might remain a very long time before the fall, and a very much longer time before they were discovered.

By the way, in all these later discussions they did not speak of the expected fall, but referred to it rather euphoniously as the Event of Merger.

Finally, the vault having been completed, the various articles for deposit were assembled, and duly installed. But as time went on, each year brought forth more things that it seemed should be deposited, until the available space was all taken up.

After much consideration, it was decided to close and seal the vault, and start the construction of a much larger one on the opposite side of the core. This would afford an additional chance of their work being found, as both could not fall directly under the core.

They were determined to put a very complete assortment of everything that pertained to their daily lives into this collection. This they proceeded to do. And it was this newer and larger one that we found. But we hope to institute a search for the old one, as soon as we can make the necessary arrangements.

We are told that it was thought wise to have the new place provided with a hall, opening into the artificial cavity surrounding the core, as well as one leading to the surface. Because they reasoned that if Vallenna was completely buried in the earth, excavators might come upon the large core and be halted; and in exploring the cavity would naturally find the museum.

It seemed almost uncanny that we should have come upon it, exactly as they had anticipated. And let us hope that we of the earth may make such good use of the wonderful things we have thus inherited, that this noble and unselfish race shall be long and gratefully remembered.

Well, at length I am back at the old home, far from Canyon Diablo and Meteor Mountain. I became so exhausted and generally run down from my long labors, and the excitement of almost continuous discovery, that my health was considered in serious danger. So Mr. Kingston and the rest have prevailed upon me to leave it all and come home for a good rest, and an opportunity to settle my nerves.

Mr. Kingston, who seems to be made of sterner stuff, is still carrying on. He seems to be entirely unaffected by what he has gone through; and is studying and inspecting just as calmly as though he were in his own laboratory, or in the drafting room of his employers.

But then, he is a scientist, with a scientist's cool and calculating methods; while I am just a normal impulsive human being. And when all is said and done, I am glad to get away for a while, and have leisure to go over all our experiences in perspective, and try to calculate the importance of our find.

The chief evidence I have of failing health, aside from my very emaciated appearance, is that I find it almost impossible to sleep. Often, when I have determinedly shut my eyes, I see a vision of that little meeting of a hundred men; and I hear the voice of the speaker, saying with prophetic emotion:—"A sudden jerk! a flash of flame! as the Vallenna strikes the earth's atmosphere; a long streak of fire, giving place to a line of smoke. A tremendous impact! And the poor little Vallenna, buried miles deep in the Earth."

THE END.

The Land of the Bipos

(Continued from Page 817)

"Weeks?" he murmured wonderingly: "Weeks? But how can that be when you have been gone but hours?"

"Hours!" we echoed, hardly crediting our eyes.

"Yes," he said, "I am telling the truth. It was but a few minutes to midnight when I turned on the ray, and you vanished; now it is only six-thirty of the following morning. Are you sure?"

"We kept no count of the days," said Red. "Living the life of the Murlos, in the burrows, time didn't seem important. Often we foraged by night and slept by day. We never counted. But a long time passed; we are sure of that."

"Strange," said Sanborn: "And yet, after all, time is merely relative; it is the great illusion, with no existence apart from matter. An hour here is a week there. What does Einstein say? You seem indeed to be two different men, in all respects."

"We are entirely different," I replied, "since we have been really living—over there."

"That is true," said Sanborn reflectively. "But it is not only a physical difference. Perhaps you are changed and the things that interested you formerly will no longer do so. As you say, this life seems more unreal than the one over there."

"Yes," said Red, "the gang is gone." He looked at Sanborn squarely: "You are responsible for this: you have changed our lives entirely. Now the Murlos are our people; we don't want to live apart from them. In that other plane or world we married; our wives are savages, it is true, but they are beautiful and faithful, and we love them."

"Ah," said Sanborn, "love! That explains it."

"Yes," answered Red, "and we have but one request to make of you."

"And that?" asked Sanborn.

"Is to send us back."

The chemist's eyes glowed. "But I wish to go there myself!" he exclaimed: "I am not only a scientist and an inventor; I would be a Christopher Columbus opening up a new planet or dimension. Oh, this is stupendous!" he cried: "Listen—we will all go back! But first I must build a bigger tube. I have plenty of money and, if need be, will spend every cent of it for the purpose.

"We will take machine guns with us," he said, "and hand grenades; weapons for offense and defense; and scientific instruments. This smaller tube we'll take with us, and those machines and electric batteries for generating the rays, so we can return to earth at will.

"Your wives?" he added: "Don't worry about your wives. If you went back at once, without proper preparation, what real help could you be to them? Besides they'll be safe from the Jahlos if they guard themselves with fire—and they'll do that. The Bipos won't bother them for a while; can't you see that? And, as for the rest, we'll make friends with the bird-masters, if we can. No wonder they think the Murlos are lower animals. The Behaviorists—well, you may not know about that—they put verbalization at the bottom of rational thinking. Perhaps they're right. If, as you say, the language was crude and mostly exclamatory, the mental pictures of the Murlos would appear confused, incoherent, beast-like.

"To think of it! Some other species with greater potentialities than man, in that other world or plane, has gone more rapidly up the evolutionary scale. But we'll educate the Murlos," he continued: "Civilize them. The Bipos won't bother us if they understand; though if they do—"

So he talked, his blue eyes gleaming, not only that day, but the next, and the next; planning, arguing, winning us over to his views, dissuading us from an immediate start.

"After all," said Red, "he is correct. Better to go back equipped for any emergency."

"Yes," I agreed.

And that is how I come to be sitting here on the verandah of Sanborn's ranch-house, in the Wetmore Range, writing this story. It is Sanborn's idea that I should put our experiences down on paper. "After all," he said, "we must tell the world the truth, even if we are called liars. But I'd like to see some people's faces if we ever return and exhibit to them a live lizard-bird."

Sanborn helps with the writing of the story, and so does Red. It is well that they do; for I am no story writer.

In another month the great tube will be finished; everything prepared. Then we will hurl ourselves once more across whatever gulf it is that separates us from the world of the Bipos and the Murlos, from the arms of Saitha and Go-ola. During the months of earthly time that have elapsed since we last saw them, we have worried and fretted; realizing that a month of earthly time may be years or more of theirs. But we are in Sanborn's hands.

God alone knows what fate awaits us in that other world. Perhaps we may perish there, slain by wild beasts or overwhelmed by the strange scientific power of the Bipos. Perhaps—though the chance is slim—we may return to astound the scientists of earth with the evidence of its existence.

But enough! Red and I are going back not for the purpose of opening up a new world or dimensions to our own, but to redeem the Murlos, and enable mankind on that other plane to rise from the status of beasts to that of civilized beings. But, more than everything else, we are going back to be with the women we love!

THE END.

Can Man Free Himself From Gravity?

(*Continued from page 780*)

the earth itself; and at a sufficient distance from the earth and from all other attracting bodies such as the moon and the other planets, the body would actually become weightless.

But how are we to attain to such heights? This question is the vital point in the attempts of many inventors—who think they can solve the problem of spatial travel by means of the "rocket ship". The rocket method of propulsion is to raise us far above the surface of the earth and in this way let us reach the moon and even the other planets. At present the solution of this problem is being presented by words and pictures. Models are being constructed. It was not long ago that an inventor lectured on this basis; stating that with his "space ship" he could readily leave the sphere of the earth's gravity and reach the planet Mars within forty hours.

But the bothersome gravity of our earth rules a heavy line through these calculations as well. How far we can actually raise ourselves above the earth with any kind of motorized machine is a problem in thermodynamics; that is to say, it is essentially a question of the fuel with which such a ship must be propelled. It can readily be calculated that the extreme limit attainable with fuels at present available is about four hundred kilometers above the surface of the earth; and at this height anybody is still fully subject to the attraction of the earth, without having the slightest possibility of rising higher. And what are four hundred kilometers compared with the 360,000 kilometers from the earth to the moon? (The mean distance is 384,000 kilometers—Editor). What is this distance compared with the hundreds of millions of kilometers between us and the other planets?

Therefore, this way also leads to no solution of the problem of escaping gravity. We are very much afraid, despite all efforts of inventors and all the rumors, groundless or well vouched for, regarding such inventions, that freedom from gravity, with all its heavenly benefits, is and will remain a dream; now and for an immeasurably long time.

WOULD WISH TO HAVE IT RESTORED

By Professor Samuel G. Barton
University of Pennsylvania

DR. WOLFF has given us an excellent discussion and I agree in the main with his conclusions. There is doubt in my mind as to just what is meant by liberating mankind from gravity. Is there to be no gravity at all? Are human bodies alone to be liberated or, in addition, other selected matter?

Gravity, we may explain, includes the centrifugal force due to the earth's rotation as well as the force of the attraction of the earth. Thus gravity consists of two distinct parts. If the attractive force of the earth could be stopped or counteracted and the centrifugal force remained, all loose material on the earth including air, water, and most buildings, would leave the earth forever and go off into space. At the equator the centrifugal force amounts to 1/289th of the weight of the body. If free from gravity, a man weighing ordinarily 145 pounds would need to grasp something solid and pull constantly with a force of half a pound or more; or he too would leave the earth.

If the centrifugal force also should be stopped or counteracted, and gravity made equivalent to zero, bodies would have no weight. Then the pressure which the upper strata of the earth's atmosphere exert on the lower strata (due to their weight) would not exist; and the gaseous air would expand and leave the earth, followed by the water which would vaporize. The moon, which is held in its orbit by the attraction of the earth would leave it, and many other drastic changes, which we need not go into, would occur.

If conditions were changed so that the human body was no longer subject to gravity, in some mysterious way, other things being as before, the change would probably be fatal; for it is very likely that our physiological and psychological processes would be so deranged that we would soon die under the new conditions. Such conditions, of course, would imply that the air, water and food which entered the body changed from a condition in which they had weight to one in which they did not. At any rate we would not need any push to "reach the highest window of the highest skyscraper." Having no weight, we would shoot up into the air and pass the window with a high velocity, and keep on going out into space. The heavy air would push us up as water pushes up a cork immersed in it. We could not "take along a wagon-load of baggage," but we could take a little for a short distance.

If some substances, not subject to gravity, could be found, the problem of using it would be the same as that of using light gases as we now do in balloons; except that the danger would be decreased.

Were those who wish to be free from gravity granted their wish they would soon be begging to have it restored; just as King Midas desired to revoke his wish that everything that he touched should turn to gold.

THE POSSIBILITY OF AVIATION WOULD BE DESTROYED

By Dr. Clyde Fisher
Curator, American Museum of Natural History

PASSENGERS in a falling airplane may wish fervently that they could "turn off" the "force of gravity"; but, taking everything into consideration, to be free from gravity may not be a condition to be desired. In order to decide the matter, let us review what we know about gravity.

As in the case of light and electricity, we do not know everything about it by any means. We know a great deal about light but, fundamentally, we do not know what it is. In like manner, we know a great deal about electricity, but we do not know what it is. Neither do we know what gravity is.

Sir Isaac Newton did not discover gravitation; but he did formulate some laws concerning it. According to his conception, every particle of matter in the universe attracts every other particle, and the force of that attraction varies inversely as the square of the distance between them. In accordance with the Law of Inverse Squares, if the distance of a body from the center of the earth were doubled, the force of gravity would be one-fourth as great.

Weight is generally defined as the measure of the earth's gravity and, as has been noted, this varies with the distance from the center of the earth. Thus a body weighs more at the poles than at the equator, and more at the base of a mountain than at the top, other things being equal.

A body at the center of the earth would have no weight, and thus, in a sense, may be said to be free from gravity. However, it is probably better to say that gravity is balanced in every direction at the center of the earth. Although a pistol bullet would weigh nothing at the center of the earth, it would penetrate just as far as on the earth's surface; for its penetration would depend upon the inertia of the mass. It is just as difficult to start or stop a body at the earth's center as any other place.

Gravity, and consequently weight, depend upon mass. A leaden ball weighs more than a wooden ball of the same size, because it contains greater mass.

Certain observed anomalies of gravity are due to the nearness of large masses of very dense or very light materials. This is believed to explain the difference in the value of gravity for points on the surface of the earth, having the same elevation, the same latitude and not far distant from each other.

After all, it seems best and clearest not to consider gravity as a causative agent, but as the manner in which things are observed to occur.

If it is a force, then perhaps, as Edison has pointed out, it is a push instead of a pull.

The defect in the reasoning about the supposed advantages of freedom from gravity lies in ignoring inertia and reaction of gravity, whatever that is. If one pushed himself up from the earth with his feet, he would not stop at the sixth floor, or any other floor. If it is gravity that holds objects to the earth, that holds particles of matter together, what would happen, if the so-called force of gravity ceased to function? Surely, some of the

imagined advantages of this condition would not come to pass. One surely could not float in the air. In fact, the possibility of aviation would be destroyed.

Clyde Fisher

THE ANSWER IN THE ACTION OF MOLECULES

By Professor A. L. Fitch
University of Maine

WHEN Sir Isaac Newton gave us the Law of Universal Gravitation, he merely gave us a mathematical expression that enables us to compute some of the actions between bodies. There is nothing in the law that explains why it is true at all, or under what conditions it fails. It seems to hold very well for large and massive bodies; but it certainly is not the whole story when we pass to very small and light bodies. If this is the only force controlling the motion of molecules within bodies, it is hard to explain why there are spaces between the molecules, even of the densest bodies, that are comparable in size to the molecules themselves. In the cases of gases, the molecules repel each other instead of attracting. If the gas in a closed vessel is partially exhausted, the remaining molecules still fill the vessel. Any small volume within the vessel will have just about as many molecules as any other equal volume. If there is no force acting here but that due to the force of gravitation, one would expect to find the molecules all in the bottom of the vessel.

It seems quite clear that there are forces of repulsion as well as of attraction between bodies. As a rule, these forces are manifest in very small bodies. If we really knew why these gas molecules repel, we might be able to answer the question as to the possibility of a gravity-annulling machine. We might be able to say definitely whether it is possible or foolish to try farther.

The situation seems now then to be that no one has so far produced such a machine. I doubt very much the possibility of one being made; but it would certainly be going too far to say that one cannot be made.

G. L. Fitch

THE EQUIVALENT OF PERPETUAL MOTION

By Professor Donald H. Menzel
Lick Observatory, University of California

MUCH has been written about gravitation nullifiers. Inventors have dreamed of finding some mysterious substance that will free mankind from the fetters that bind him to the earth. Who would not like to own a rug made of this material, so that all objects within a room would hang, weightless, in space? Lift a grand piano with one finger, balance yourself on the ceiling, sleep in midair—all these are fancies of the imagination that will never come to pass, at least in the sense implied above.

Too bad that Science's cold water must awaken us from these rosy dreams! The statement, "Anything is possible", has become such a truism in these days of accomplishment that people forget there are some things that will never come about. We shall never be able to get something for nothing! Matter and energy cannot be created nor can they be destroyed. Perpetual motion is ever an unattainable goal. If one could discover some substance that would insulate from gravity, but an infinitesimal amount of energy would be required to lift a ton weight. Now kick the nullifying screen out of the way. As the mass crashes to the ground it could be hitched to machines and made to do useful work. Since the process, presumably, could be repeated over and over again, we should attain the equivalent of perpetual motion. Since this is impossible, I feel sure that inert anti-gravational screens are impossible.

Is there no hope then for earthbound mortals? Are we never to escape gravitation? Answer that question by looking around you. The great gas-bag of the Graf Zeppelin is a gravity nullifier. An airplane, a high-powered motor-car, an elevator—an endless list of things—yes, you yourself are a gravitation nullifier or, as perhaps I should say, a gravitation defier. Every time that you walk up a hill you are defying the earth's attraction. But in no case are you getting something for nothing. It takes energy, not an inert shield, to overcome gravitation.

At first glance, it may seem that a balloon or Zeppelin may rise without expenditure of energy, but this is not true. The potential energy lies in the very light gas that fills the bag, and a little thought will convince you that its lifting power could be employed but once if external aid, such as motors or powerful compressors, were not resorted to.

Since the advent of relativity, gravitation has not been such a mystery. Modern investigation of atomic structure has done even more to elucidate the problem. The recent theories of Dr. Weyl are particularly illuminating; they appear to indicate that gravitation is inseparable from the atom. Our only hope for freedom lies in the exploitation of electrical, magnetic, or other forms of mechanical energy; gravitation nullifiers are will-o'-the-wisps that will never come to pass.

Donald H. Menzel

NOTHING POINTS TO ITS FAILURE OR REALIZATION

By Prof. C. Irwin Palmer
Armour Institute of Technology

FROM present determined laws of science, it is nonsense to argue for or against the possibility of overcoming the force of gravity. But there is a fairyland of science, the realm of many dreams and fantastic imaginings, and some of these dreams come true; while many are doomed because they are in conflict with laws of nature, known or unknown.

We believe that the dreams which have caused many to devote their lives in an endeavor to perfect perpetual-motion machines will never come true, for they are in direct conflict with proved principles of science. Alchemy, a dream of many both in ancient and modern times, and long supposed impossible by scientists, has been thrown into the field of possibility by new discoveries.

The overcoming of gravity is a dream. Nothing in science inevitably points to the failure or its realization. Other fields of force can readily be set up, at least in a limited way, which counteract the force of gravity; and nothing now known proves that it is impossible to extend these fields.

The force of gravity varies at different points on the surface of the earth, and Dr. Wolff seems to imply that this is wholly due to the difference in the distances of these points from the center of the earth. However, it is well established that, while the force of gravity at the poles exceeds that at the equator by about one part in 189, the difference in the distances from the center accounts for only one part in 555 and the centrifugal force accounts for one part in 289. This indicates that, if the velocity of the revolution of the earth on its axis were seventeen times as great, a body, dropped near the surface of the earth at a point north or south of the equator, would fall parallel to the earth's axis; and, if dropped at the equator, the body would have no tendency to approach the earth.

Even if the extreme limit attainable above the surface of the earth by fuel at present available is, as stated by Dr. Wolff, 400 kilometers, this in no way proves that a higher elevation could not be attained by some other means. What about the possibilities of using atomic forces? It is well within reason, and the present trend of science indicates it, that such forces or some form of radiation can be controlled in such a manner that the force of gravity will offer no hindrance in traveling any distance from the earth.

C. Irwin Palmer

GRAVITATION HAS BEEN OVERCOME

By Professor James Byrnie Shaw
University of Illinois

GRAVITATION is no more mysterious than any other of the "forces of nature." It has actually been overcome in many ways for centuries. The idea that it, or any other "force" can be annihilated, is the only dream about it. As the years go on, gravitation will be more and more successfully controlled. At one time electricity and magnetism were even more mysterious than ever gravitation has been, yet today they are handled like toys. And, to be brief, every physicist and mathema-

(*Concluded on Page 850*)

Science News of the Month

ASTRONOMY—METEOROLOGY

SOLAR SYSTEM SPEEDING TOWARD STELLAR DRAGON

The earth and the rest of the solar system are rushing at a rate of some six miles a second toward the portion of the northern sky in which is seen the constellation of the Dragon, Dr. Dayton C. Miller of the Case School of Applied Science, Cleveland, has discovered. That there are at least twelve different experimental evidences of such a cosmic motion of the solar system, is announced by Dr. Miller for the first time in a report to the National Academy of Sciences. Among these are the famous ether-drift tests that he has been making for the past decade. This year's tests were made at Cleveland, within three hundred feet of the location of the original Michelson-Morley experiment on ether drift upon whose supposed negative result Einstein supported his theory of relativity. Dr. Miller, on the basis of a reinvestigation of the original test data and thousands of observations of his own on Mount Wilson and at Cleveland, concludes that the original experiment of 1887, cited in every textbook as proof that there is no ether, in reality shows the same sort of motion that he has found in his much more extensive repetitions of the experiment. At present Dr. Miller has no theory to account for the cosmic effect he finds in his own experiments and the observations of others. But he urges scientists to reconsider the evidence that such cosmic motion is real and needs explanation.

SAYS COSMIC RAYS ARE CLUE TO CREATION

Professor Robert A. Millikan, famous physicist, and director of the California Institute of Technology, declared before the National Academy of Sciences that recent experiments indicate that waves of energy accompany the creation of atoms in space. He spoke of new measurements showing the intensity of cosmic rays as a function of depth beneath the surface of the atmosphere. These measurements were made by him with newly-devised and very sensitive instruments in tunnels and lakes; and also on Pike's Peak, and other high elevations. It was found that the shortest rays penetrate 500 feet into the earth, or twice as far as had been shown in previous experiments.

Dr. Millikan believes that the shortest of these rays may emanate from the creation of helium in space, and the longest rays from the creation of iron. The fact that a certain type of cosmic ray is produced, every time an atom of iron is formed, has led Professor Millikan to believe that there is a close relationship between the various types of rays and the elements composing the universe. Each ray is supposed to correspond in the birth of an atom at some time.

MEASURE HOLD ON UNIVERSE

The importance of the study of meteors and meteorites in man's effort to understand the nature of the universe cannot be exaggerated, according to Dr. Harlow Shapley, of Harvard University. "Our contact with the outside universe comes only through two media, light and meteors. The meteors that filter down through the atmosphere as meteorites provide opportunities for significant chemical analysis. It is estimated that a thousand million meteoric particles collide with the earth's atmosphere every twenty-four hours, and all but the largest and slowest are burned in the atmosphere." Prolonged studies of the numbers and motions of meteors are said to contribute a test of theories of the origin of the earth, especially of the planetesimal hypothesis. The planetesimals are one class of meteors.

"There is a close connection between the clouds of meteors moving across the solar system and the great diffuse nebulae of the Milky Way," said Dr. Shapley. "The nebulae are believed to be factors in the evolution of stars; and therefore studies of meteors will help to interpret the nature of the nebulae and their role in the evolution of stars and planets."

LONGEST ECLIPSE 7½ MINUTES

The longest possible eclipse of the sun can last only 7 minutes and 31 seconds, according to Mrs. Isabel Lewis, of the United States Naval Observatory, who has done a great deal of work on the subject. No astronomer will ever see an eclipse of eight minutes.

A total eclipse of the sun occurs when the moon's shadow touches the surface of the earth. The shadow is a cone; so it is evident where it hits the earth, when the moon is nearest the earth and the sun farthest. Furthermore, to get the longest period of eclipse, the shadow must fall on the equator, so that the observer may travel fastest with the shadow, in order to have the longest possible eclipse. Under these conditions, the maximum length of time the sun is obscured will be 7 minutes and 31 seconds.

ARTIFICIAL LIGHTS WOULD SHOW MARTIAN INTELLIGENCE

Dr. Clyde Fisher, of the American Museum of Natural History, has expressed the hope that the new 200-inch telescope to be constructed in California will settle the question whether there are intelligent creatures on the planet Mars. It will be possible to distinguish cities, and even the lights from arc lamps, if they exist on Mars.

No cities or artificial lights have yet been seen; and from this it is possible to infer that, if intelligent beings do exist on Mars, they either have not developed their civilization in the same direction as ours, or have not reached our present pitch of utilization of natural resources and modification of the face of the planet.

AVIATION

AVIATION PROGRESS SLOW, SAYS EXPERT

A profound dissatisfaction with the progress made in the development of the airplane since the days of Wright's Kitty Hawk, characterized the statement of Grover Loening, aeronautical expert in the the *New York American*. Mr. Loening is one of the pioneers in aviation in America, having been associated with the Wrights during their early days. Mr Loening's indictment is directed against the exploitation of aviation as a commercial venture at the expense of the development of planes. Although we have made great strides in the *refinement* of design in planes and in the *use* of the planes (development of airports, use of beacons and radio communication) we have made very little progress in the development of *new principles of airplanes*. A much greater safety and greater speeds are necessary to justify our claims to progress. What is necessary, he says, are planes capable of doing 300 miles per hour, climbing 25,000 feet altitudes above storms and clouds, landing at lower speeds and rising more quickly; and the universal use of amphibians. Better designing of planes, improvement in engines, higher power and efficiency, and use of lighter fuels are all necessary to get 300 mile an hour planes, capable of having that speed during sustained flights. The three greatest dangers to distance flying, he said—fuel-consuming headwinds, fogs and ice-forming weather,—would be avoided by the planes he advocates.

GIANT AIRSHIPS PLANNED

Coincidently with the plans for the building of a huge hangar for lighter-than-air craft at Akron, Ohio, for the United States Navy, comes the statement that the large aircraft of the future will be the lighter-than-air type. For with the sciences of this type of craft being understood, there is virtually no limit to the size possible, since really the effective load possible increases proportionately with the size. With the heavier-than-air machines, however, increases in size bring increases in weight which reduce the carrying efficiency. The new hangar, which will be on rollers to compensate for temperature changes, will have a ground area of 1,500,000 square feet, or equal to that of fourteen regulation football fields. In it will be constructed ships for the navy that will exceed greatly those of the past.

FINDS NEW EXPLOSIVE FOR ROCKET PLANES

A new explosive has now been invented for propelling rocket airplanes. It is expected to prove a great advance over the old powder rockets used by Opel and others. The new explosive combines the use of an "oxygen-bearer," hitherto unused, which was found in a by-product of the chemical industry, together with a "carbon-bearer" in the combustion chamber. At the moment of contact the two substances in the form of liquids are raised to combustion temperature.

The new explosive develops a force four times greater than that of the powder rocket, and its cost is only one-third greater than its equivalent in gasoline. The new explosive permits a forty-minute flight for one rocket, as compared with forty seconds by the use of powder.

ENGLISH ROBOT PILOT STEERS PLANES

An automatic mechanical piloting mechanism for planes has been perfected in England. This device, a development of the Royal Air Force, has been successfully tried out in various types of planes—two-seater day bombers, large twin-engine night bombers, and big flying boats. It is being considered as a second or relief pilot for long distance flights.

In every test the robot pilot has steered an accurate course for hours at a time over distances up to 400 miles, while the human members of the crews were occupied in other work. The basis of the mechanical pilot is a gyroscope that controls pistons connected with the rudder and elevators of the plane. These pistons are actuated by compressed air. Once a course is set, the robot pilot, similar in principle to the Sperry gyroscope stabilizer used here, keeps the machine on its route, and errors of even a fraction of a degree are instantly and automatically detected and corrected. All the human pilot has to do with the robot-equipped plane is to take off and land the machine.

BIOLOGY—EVOLUTION

EXISTENCE OF "MISSING LINK" SKULLS DOUBTED

Pithecanthropus, the "man of Java," and *Eoanthropus*, the "dawn man" of Piltdown, England, are looked upon with doubting eyes by Gerrit S. Miller, Jr., curator of mammals of the U. S. National Museum. In the Annual Report of the Smithsonian Institution, just off the press, he sums up all the arguments thus far advanced both for and against the recognition of these two extinct species as links between human and simian, and ends by remanding the case pending the discovery of further evidence. This is in direct opposition to the opinions of perhaps a majority of anthropologists, and certainly to the popular impression regarding these fossils; which is that they are unquestionably human, though resembling the apes more than modern man does.

Mr. Miller has concluded that: "Two facts, if no others, must be admitted to stand out from the mass of opinion which we have been trying to follow—namely, that these fossils have furnished an unparalleled stimulus to investigation, and that the things most needed now are more fossils and many of them. While awaiting these further discoveries, we should not hesitate to confess that, in place of demonstrable links between man and other mammals, we now possess nothing more than some fossils so fragmentary that they are susceptible of being interpreted as such links or as something else."

GORILLAS, LIKE MEN, ALL ONE SPECIES

Like their more successful and more widespread human cousins, the gorillas of equatorial Africa are all members of one species. Within the species, they can be definitely differentiated into two zoological varieties, called for convenience the coastal and the mountain varieties. Beyond this, all differences hitherto described can not be made out as anything more than local, and probably fluctuating and impermanent. These conclusions are set forth by a young Harvard zoologist, Harold Jefferson Coolidge, Jr., in a monograph on this interesting ape just off the Harvard University press. Mr. Coolidge has made an exhaustive study of all available skeletal material on the gorilla and has examined all the scientific literature in existence bearing on the question of its zoological position.

The two varieties, coast and mountain gorillas, live in ranges separated from each other by a considerable stretch of territory in which there are apparently no gorillas at all. Thus isolated and prevented from interbreeding, each group has developed and preserved certain peculiarities of its own, most notably in the proportions of the skull. The coast gorilla has a skull that averages a little longer and wider than that of the mountain variety, but the mountain gorilla has a larger jaw and ampler mouth cavity than his lowland brother possesses.

BONES GROWN IN TEST TUBES

A most amazing case of living tissue being grown outside the animal body is the development of embryo gristle or cartilage into bone—a remarkable transformation which has been accomplished by Miss Honor B. Fell, working at the Strangeways Research Laboratory in Cambridge, England.

When the proper conditions of nourishment and temperature are maintained, isolated cells from animal embryos have been seen to grow and develop in the test tube, just as though they were in the animal body. Miss Fell, using a technique similar to one devised by the late Mr. Strangeways, has cultivated tiny pieces of gristle from six-day-old embryos of fowl. During cultivation, they increased to more than three times their original length, and developed along practically normal lines.

USE RADIUM IN PLANT EVOLUTION

Professor T. H. Goodspeed, writing in the *New York Herald Tribune*, has described various methods whereby radium rays and X-rays are used in the study of plant and animal life, and by means of which their evolution may be accelerated.

X-rays and radium have powerful effects on living organisms; and experiments with tobacco seeds and flowers have demonstrated that in the first generation following X-raying very definite changes are produced in the living tissues. The rays used are the high-speed "gamma" rays of radium. All other radium rays are excluded by special apparatus. An overdose of the rays causes injury to the organism; whereas a small dose will speed up a slow-germinating plant and make it equal in every respect to a normal plant. The "gamma" rays applied to a plant in which cells have begun to multiply cause distortion, and the death of many embryos. When the "gamma" rays are applied to growing sex cells, rather than to other tissues, sterilization usually results.

THEORY OF MUTATIONS LINKS MAN AND APE

According to Professor H. H. Sheldon, writing in the *New York Herald Tribune*, scientists have bridged the gap between man and the ape by the theory of mutations from a common ancestor. New forms of life that appear are explained as departures from the law of inheritance.

Mutation is the production of a new form through change. The units of heredity are the *chromosomes*. In human cells there are 24 of these; at conception, 12 are chosen from each of the male and female germ cells. Each *chromosome* is responsible for the transmission of the characteristics which are thought to reside in the *genes*, or collection of molecules which go to make up the *chromosomes*. Since it is improbable that the same *chromosomes* would be chosen by chance on any two matings, it is also improbable that two members of the same family will resemble each other in all details. Sometimes, of course, great ability may be transmitted but, usually, after the production of a genius, a family falls back immediately into its mediocrity.

Scientists, trying to bridge the gap between the ape and the Neanderthal man, and the Neanderthal and the Cro-Magnon, have been forced to the theory of mutations. This is the only explanation given for the vast changes that have taken place in the organism in only a few thousand years of evolution.

CHEMISTRY

HYDROLYZATION OF WOOD PRODUCES FOODSTUFFS

Professor Friedrich Bergius, of Berlin, has urged the production of food from wood. Such chemical transformation is quite possible, through the "hydrolyzation" of the wood; and the food produced will be fit for animal consumption, and possibly for human use.

Germany imports three to four million long tons of corn and barley annually. Dr. Bergius believes that at least one-fourth could be replaced by hydrolytic products, for which only three to five million cubic meters of ordinary firewood will be required. The nutritive value of a pound of firewood equals the food value of the same amount of oats, but the wood is much cheaper.

The combination of potatoes and wood food will have the same nutritive value that potatoes alone have, and the cost will be only half. In addition to foodstuffs, a considerable amount of acetic acid is obtained by hydrolyzation; and the remains of the wood are finally pressed into bricks which have the same heating value as brown coal briquets.

RADIUM BELIEVED TO EXIST IN PLANTS

Radium, in infinitesimal amounts, is to be found in all living plants and animals. According to Professor V. J. Vernadsky, who has conducted investigations at the Russian State Radium Institute and the Biogeochemical Laboratory, it is gathered up by them and concentrated from its even thinner distribution in natural soil and water.

Surface water from a fresh water pond showed the presence of radium in amounts inconceivably small—its concentration being .000000000000068 of one per cent. A sample from a deeper part of the pool contained a trifle more. Two species of floating duckweed from the pool's surface showed a concentration 56 times as great as the pool, in spite of the fact that the plant is itself over 90% water.

UNDER TURNER DIRECTION PANAMA CANAL LOCKS

The largest smoke screen ever laid was used lately in Panama to hide the locks of the canal. The screen was an experiment of the Chemical Warfare Section. Huge candles of phosphorus were lighted on the tops of the hills surrounding the Pacific locks. The green mountains suddenly took on the appearance of active volcanoes, and in less than half an hour the drifting smoke completely blotted out the locks from all observation by planes.

"Science News of the Month"

portrays in plain yet concise language every important scientific advance during the month. Nowhere can the average reader get such a wealth of accurate and vital information condensed into such a small volume. Some 42 scientific journals as well as a score of other sources are utilized by our editors in the compilation of this department. The publishers welcome short contributions to these pages from the various scientific institutions, laboratories, etc.

GAS TO BE FORMED FROM CORNSTALKS

A gas to be made from the pith of cornstalks will furnish fuel to generate electricity, for use in the corn belt, said Professor A. M. Buswell, chief of the Illinois State water supply, at the meeting of the American Chemical Society in Minneapolis. This gas, it is explained, would be formed by placing cornstalks in a closed fermentation tank into which the farmer's household wastes also will be allowed to run; thus furnishing the necessary nitrogenous materials for the bacteria conducting the fermentation. The result is a gaseous mixture of carbon dioxide and methane, or marsh gas, having a heat value equal to that of ordinary gas used in cities. A tank 6 feet in diameter and 8 feet deep, connected to the family drain, is expected to furnish enough gas to supply the requirements of a family of four or five. A ton of cornstalk, it was estimated, would yield from 14,000 to 20,000 cubic feet of gas.

ARTILLERY WILL FIRE TEAR GAS

Major-General H. L. Gilchrist, chief of the Chemical Warfare Service, has outlined a plan whereby artillery units will fire long-range tear-gas shells. According to the general's report, the number of machine guns used in modern warfare makes it impossible for infantry to advance against them without the protection of artillery, armor, or smoke screens. The first two are too expensive to be used at all times and the latter is not very effective; although a great advance has been made in smoke-screen production by airplanes and tanks.

Extensive tests have been made of the use of tear gas as a weapon of offense and defense. Artillery shells of 75-mm. (three-inch) caliber were filled with solidified *chloracetophenone*, and it was possible to produce "a strong lachrymatory cloud which would force the use of masks at all positions within 550 yards down wind from the point of impact." Ordinary gas can be observed as it is borne by the wind; but gases in shells cannot be guarded against, and the tear gas will have an immediate disabling effect.

GEOLOGY

EARTHQUAKE ROCKS NORTH ATLANTIC COAST

An earthquake, with its center about 800 miles from New York City, rocked the entire Atlantic coast from New York northward to Newfoundland and Nova Scotia recently. The quake, which was hardly apparent at its southern extremity, was most violent in Nova Scotia, where the earth tremors lasted an hour, and buildings rocked on their foundations.

Authorities at Harvard University stated that the earthquake was on the "Fundian Fault," extending southwest under the Atlantic Ocean from the Bay of Fundy down along the New England coast. The earthquake was accompanied by great tides all along the affected sea-coast, reaching in Boston to 14 feet. The idea of an earth tremor affecting the tides was explained by Father Joseph Lynch, in charge of the seismograph at Fordham University. "The idea can best be illustrated," said the scientist, "by picturing a pebble dropped in the water. The point where the pebble hits would correspond to the center of the disturbance, and the tides that come up so suddenly hundreds of miles away would correspond to the ripples caused by the pebble hitting the water."

In the earthquake ten undersea cables were broken, proving that the tremors were more violent on the bed of the ocean than on land. Great damage was done along the southern coast of Newfoundland, where the depth of water was in places altered.

BIBLICAL FLOODS PROVED

Dispute about the authenticity of the facts recorded in the Bible will receive a new lease of life on the reports from the Field Museum-Oxford University expedition to Mesopotamia. Discoveries unearthed in Sumeria, according to a report, prove that two terrible floods similar to those recorded in the Old Testament occurred. The first is estimated to have happened about 4000 B. C., and the second, which the bible states to be that in which Noah took a historic part, occurred about 3400 B. C. Workers have uncovered a city which has been twice destroyed and upon this discovery they base their theories as to what happened in those uncertain days.

TRACE GLACIERS BY CLAY DEPOSITS

It is possible to trace the paths of the glaciers of the ice ages in the clay of the North American continent, according to Dr. Chester A. Reeds, of the American Museum of Natural History. The retreat of the last glacier from Staten Island, New York, to Canada, during a period of 29,000 years, has been traced by the study of 38,000 layers of clay in and about the vicinity of New York.

The glacier, as it retreated, left behind it layers of mud, one for each year. Each layer consisted of two strata (the summer and winter deposits) which can be traced in the clay by their varying thicknesses. The annual deposits were about an inch and three-eighths thick; the summer layer being twice as thick as the winter, because of the more rapid melting of the ice.

MEDICINE

USE ELECTRICITY TO TREAT DISEASE

A new use for electricity in medicine has been reported to the Southern Medical Association by Dr. Edwin W. Cocke, superintendent of the Western State Hospital at Bolivar, Tenn., and Dr. J. Cash King of Memphis. These physicians have been using electricity to produce the fever which has been found useful in treating paresis. In the last few years science has been using fever to fight certain diseases, notable among them the final stages of venereal disease. Various ways of producing the fever have been tried. Inoculation with malaria has been the most widely used, but it has disadvantages. Drs. Cocke and King have obtained good results by using an electric current from a diathermic machine to produce the fever. Better control of the degree and duration of the fever are among the advantages of this method.

The use of artificially-induced fever in treating certain diseases is based on the theory that fever is one of the major defensive measures of the body against invading organisms. Almost all of the self-limiting diseases are accompanied by fever; but certain classes of diseases and disease condition which are not usually self-limiting are not accompanied by fever except in the last stages, Drs. Cocke and King pointed out. It is for these conditions that artificially-induced fever has been found successful in overcoming the disease and causing disappearance of symptoms.

REACHES HEART THROUGH A VEIN

A young Berlin surgeon, Dr. Werner Forssmann, according to the *New York Times*, has succeeded in propelling a rubber catheter (tubular instrument) through a vein in his left arm to the right auricle of his heart. Using only a local anaesthetic, the surgeon inserted a highly-sterilized and well-lubricated rubber catheter, about 2 feet 13½ inches long, into the vein directly above the left elbow. According to the *Times* article, by carefully manipulating it upward and under the collarbone, he succeeded in locating the stump artery through which he passed the instrument into his heart. The operation lasted less than a minute and produced no ill effects.

TWO NEW VITAMINS DISCOVERED

No less than two new vitamins have recently been discovered by English scientists. Katherine Hope Coward and her colleagues at the Laboratory of the Pharmaceutical Society in London have just published a paper describing a new vitamin which has escaped notice before. Scientists do not yet know whether it is necessary to the human race, but Miss Coward's experiments have proved that it is necessary for the growth of that all-important animal, the experimental rat. No name has yet been given to this vitamin, which has been found in fresh milk, lettuce, grass, ox muscle, liver, and wheat embryo.

The other new vitamin has recently been described by Vera Reader of the Biochemical Department of Oxford University. The original Vitamin B was said to prevent beri-beri. Scientists found later that Vitamin B really consists of at least two separate compounds, which they decided to call B1 and B2. Miss Reader now has found that in the Vitamin B of yeast there is a third growth factor.

ULTRA-VIOLET RAYS CALLED DANGEROUS

In a warning against the use of various electrical devices which are advertised as substitutes for sunlight, the United States Public Health Service has classified some of the "sun-ray" machines as either useless or dangerous.

Several kinds of rays exist in sunlight—visible and invisible rays—and these are omitted also by the carbon-arc lamp and the mercury-arc lamp. But "no artificial source of light is comparable to the sun, in favorable localities, in either the relative intensity or the nature of the rays emitted. Ultra-violet rays may cause serious injury to the eyes; the development of skin symptoms in persons with a tendency to pellagra; serious symptoms at times in persons with low blood pressure; and may be harmful to persons with symptoms of early tuberculosis. Exposure to ultra-violet radiation may cause great restlessness, and, in overdoses, anemia. Severe burns may be also experienced. Considering the potential harm from this therapeutic agent, no one should indulge in self-treatment."

PHYSICS

OBSERVATORY RECORDS ATMOSPHERIC ELECTRICITY

The United States has completed the building of its first complete observatory for detecting and recording the existence of atmospheric electricity. Located at Tucson, Arizona, the observatory is the third of its kind in the world.

Instruments placed in utter darkness and away from the shock of the outside world measure the electrical conductivity of the atmosphere; from their records scientists may observe variations of the potential gradient of the open air. These records consist of light traces written in jagged lines across tracing paper.

The devices are protected by a solid concrete wall, followed by a two-foot enclosed air chamber, and a *masonite* insulation which makes the inner protecting wall four feet thick. The entire structure is enclosed from the outside by a corridor of *louvre* walls. Space in the building (called a "box") has been provided for the installation of instruments for the measurement of the degrees of atmospheric conductivity, and of the electrical currents which run within the earth.

ELECTRON FOUND TO HAVE DUAL CHARACTER

G. P. Thompson, British scientist, has made a new discovery in the field of physics. He states that the electron acts like a flying particle and also behaves like a wave. He rolled gold, nickel, aluminum and other metals, each to about one-tenth the thickness of a gold leaf, and shot electrons through them. After passing through the films the electrons came in contact with a photographic film, and were recorded as concentric circles and as other circular patterns.

WILL REGULATE EARTH'S HEAT BY GAS CURTAIN

A Cuban inventor, Christian Schmidt Alexander, has devised a plan whereby, with the use of a certain gas, he proposes to regulate the heat from the sun in summer. The gas, one of his own developments, will be spread evenly at a certain height by airplanes, to intercept the rays of the sun. In addition, it is expected to remain at a fixed height, and in the space between the bottom of this gaseous blanket, and the earth, ocean breezes will circulate freely, cooling the atmosphere. This discovery will be useful only at the equator.

VIOLET RAYS BRING BACK ERASED WRITING

The old medieval scribes, in order to save the expense of costly parchments, often erased what had been written on old manuscript sheets and used them again. In this way, many works of genuine value were lost to the modern world. A method has been developed by Professor G. R. Kogel, of Vienna, by the use of which the erased writings of "palimpsests" will again be made visible.

The new device photographs the ghost writings. A mercury vapor lamp is used which generates ultra-violet rays, and a filter of glass, almost black, which transmits only the invisible rays. Many dyes and other substances take on a curious glow, or fluorescence, when examined beneath the rays; each substance exhibits a characteristic color. By using a special filter, it is possible to eliminate the surface writings; thus allowing the instrument to photograph the words that are brought to light by the ultra-violet ray.

TO GENERATE POWER FROM GULF STREAM

The French scientist Claude, developer of neon gas lights and important synthetic processes, is proceeding with an extensive investigation at Matanzas, Cuba, of the possibilities of harnessing the potential heat energy of the Gulf Stream.

The surface water at the gulf is 40 degrees warmer than the water 2,000 feet below. M. Claude expects to generate steam by developing a practical device for transferring this potential heat energy and using it. The preliminary plans involve dropping a pipe line to the bottom to bring up the cold water and taking off the power through the use of a turbine engine, which takes advantage of the flow of vapor set free by the proximity of water at two different temperatures.

RADIO-TELEVISION

NEW CATHODE-RAY TUBE ADVANCES TELEVISION

Television apparatus is rapidly approaching a point where it will be eminently practical for home use. The latest development does away with the usual whirling disks and neon tubes. The disc, utilized heretofore to scan images, has been eliminated from the circuit by Dr. Vladimir Zworykin, engineer for the Westinghouse Electric and Manufacturing Company, who has introduced the cathode-ray tube to produce the beams of light that paint the images on the screen.

The images formed by the cathode-ray device measure 4 by 5 inches. A new type of tube, the "kinescope", has been developed. A pencil of electrons from the cathode tube bombards a screen of *fluorescent* material—a substance which becomes brilliant where the electrons strike. The pencil of electrons follows the movement of the scanning light beam in the transmitter, while its intensity is regulated by the strength of the impulses received. The movements of the scanning beam, and consequently of the cathode-ray pencil, are so rapid that the eye receives a perfect impression of a continuous miniature motion picture. A reflecting mirror mounted on the receiver permits the picture to be observed by a number of spectators.

BYRD EXPEDITION TO STUDY "RADIO ROOF"

Among the important scientific studies that are to be made by the Byrd Antarctic Expedition is one of a disputed question of radio phenomena. The expedition has been in constant touch with the North American continent through short wave radio transmission. These waves, however, leave several problems still unsolved. One of these is the investigation of the little-understood Kennelly-Heaviside layer (radio roof) which is supposed to exert great influence upon broadcasting and radio transmission in general. In studying this theoretical layer, the expedition is using an oaiso, a device developed by the late Joseph W. Legg, oscillographic expert, to measure the distortion of sound which occurs when waves are echoed. The very short waves are timed and their direct reception and their reception after being deflected from the layer are noted. The time between the signal and the echo is too short to be determined by ear; so, instead, the signal is made visible, and a picture is taken. Then a ruler can be used to measure the difference in travelling time of the [illegible]

INVENTION TO END RADIO INTERFERENCE

Dr. James Robinson, former chief of the Wireless Research Department of the British Air Ministry, asserts he has invented a revolutionary system of radio transmission which reduces interference between broadcast stations to a negligible factor.

Congestion on the air in Europe is very acute, and the wavelengths of many stations overlap. It is said that the new device is to do away with this inconvenience, and it will permit "radio telephony to be received on a frequency-band of 100 cycles or less, as compared with the present-day practise of over 9000 cycles." The "radiostat"—as the invention is called—will, it is claimed, enable 5000 stations to work at the same time on wavelengths between 300 to 600 meters, instead of the 25 stations which operate at the present time.

(*Continued on Page* 851)

[illegible] RADIOPHONE PROVES SUCCESSFUL

A new advance has been made in radiophone communication through the tests made by the *DO-X*, the world's largest airplane. The plane, while in flight, called a shipyard in Switzerland, which relayed the message over ordinary telephone wires to a radio station at Stuttgart where the call was broadcast. It was picked up by all German stations, and also in Berne (Switzerland) Zurich, London, and Vienna.

Passengers on the airplane were even able to understand the return messages; because special amplifiers overcame the roar of the twelve great motors of the giant airplane.

RADIO DETECTIVE NOW USED

An electric "radio detective" is in use in Turin, Italy, to disclose "bootleg" radio receivers. In Italy, as in many European countries, radio reception is not free. A license fee must be paid before a receiver may be installed and programs received. Many persons build receivers in secret and conceal the antenna, avoiding the payment of the fee.

The new "radio detective" discovers them very quickly. Nearly all radio receivers in use draw from power lines the current to operate the vacuum tubes. Under these circumstances, a ripple is created on the smooth flow of the electric current, like the tiny ripple a stone may create on the surface of a running brook, when it is on the bottom.

When attached for a few moments to the electric wires as they enter the house, the "radio detective" picks up this tiny electric ripple and magnifies it. Houses where no radio license is in force are searched for the illicit radio sets.

$100.00 in GOLD for a SLOGAN

for

Science WONDER Stories

A few moments of your spare time NOW may bring you $100.00 in gold.

WE want a catchy slogan for this magazine. Slogans are now used universally in many different lines of business; we believe that this magazine should be known by its own slogan.

Such slogans as "Not a Cough in a Carload;" "Good to the Last Drop;" "Say it with Flowers;" etc., are well known. A number of magazines have already adopted slogans; such, for instance, as *Popular Mechanics*, with "Written So You Can Understand It."

REMEMBER, THERE IS NOTHING TO BUY OR SELL!

You have an equal chance to win this prize, *regardless of whether or not you are a subscriber.* The contest is open to all. Get your [illegible] in on this and, if they give you suggestions, you may split the prize with them, if you so desire.

To win the $100.00 prize, you must submit a single slogan, *one only.* It must be an original idea. It makes no difference who you are or where you live, whether in this country or not, anyone may compete in this contest and you may be the winner.

Look this magazine over carefully and try to find out what it [illegible] for, what its ideals are, and what it tries to accomplish. Then try to put all of your findings into a slogan which must not, under [illegible] circumstances, have more than seven words.

After you have the idea, try to improve upon it by shortening the slogan and making it sound more euphonious; but always remember that it is the idea which counts. The cleverer the slogan, and the better it expresses the ideas for which this magazine stands, the more likely are you to win the prize.

No great amount of time need be spent in the preparation of slogans. Start thinking right now and jot down your thoughts. Also, tell your friends about it, and get them to submit slogans of their own; or compose one in partnership with them.

Here are a couple of sample slogans; which are given as mere suggestions, and not to be used as entries:

"THE MAGAZINE OF SCIENCE FICTION"
"SCIENCE TAUGHT THROUGH FICTION"

RULES FOR THE CONTEST

(1) The slogan contest is open to everyone except members of the organization of SCIENCE WONDER STORIES and their families.
(2) Each contestant may send in only one slogan; no more.
(3) Slogans must be written legibly or typed on the special coupon published on page 853 of this [illegible] (If you do not wish to cut the magazine, copy the coupon on a sheet of paper exactly the same size as the coupon). Use only ink or typewriter; pencilled matter will not be considered.
(4) Each slogan must be accompanied by a letter stating, in 200 words, or less, your reasons for selecting this slogan.
(5) In case of duplication of a slogan, the judges will award the prize to the writer of the best letter; the one which, in their opinion, gives the most logical reasons for the slogan.

This contest closes on May 1, 1930 at which time all entries must be in this office; and the name of the winner will be announced in the July, 1930, issue of SCIENCE WONDER STORIES, on publication of which the prize will be paid.

Because of the large number of entries which may be expected, the publishers cannot enter into correspondence regarding this contest.

Address all communications to:

Editor, Slogan Contest,
Care of SCIENCE WONDER STORIES
96-98 Park Place, New York, N. Y.

Science Questions and Answers

THIS department is conducted for the benefit of readers who have pertinent queries on modern scientific discoveries and on established scientific facts. As space is limited we cannot undertake to answer more than three questions for each letter. The flood of correspondence received makes it impractical, also to print answers as soon as we receive questions. However, questions of general interest will receive careful attention. If you desire individual answers to your queries, enclose 25c in postage to cover time and mailing.

The Speed of Celestial Bodies

Editor, Science Questions and Answers:

Will you answer a question for me? I have read a paper by Dr. Walter Adams, director of the Mount Wilson Observatory, on the speed of celestial bodies. He says that Nebula N.G.C. 4860 has an apparent speed of 4800 miles per second. He also says that this nebula is about fifty million light-years distant from us. How does an astronomer measure the speed of bodies at such an enormous distance from us? Suppose it moved at 4800 miles per second for hundreds of years; would it not appear to be in the same position to an observer on earth?

Archie Walker,
339 Alexandra Street,
Sydney, Nova Scotia,
[redacted]

(An astronomer measures the speed of celestial bodies by means of two instruments; particularly the spectroscope, which breaks the light from the star up into its spectrum of component colors, ranging from violet to red; and also the micrometer, a measuring device which determines very small distances with very high precision. When the "special lines" ordinarily seen in the spectroscope are shifted out of their proper position, we know that the bodies observed are in motion toward or away from the earth. This discovery we owe to the astronomer Doppler; it is known now as "Doppler's Principle." Measurements are made of the relative positions of the images on the spectroscope. Red has long light-waves; violet light-waves are shortest. Thus, if a source of light, such as a star, or nebula, is moving away from us at the time of observation, we receive fewer light-waves per second than if the distance remained the same. But, if we receive fewer waves, they appear to be longer; and therefore the waves are crowded toward the red end of the spectrum. The effect is to shift also toward the red end of the spectrum the characteristic lines caused by each element. The amount of this shift is measured with the micrometer; and from such measurements it is possible to determine the speed with which a source of light is approaching or receding from the earth in space.—Editor).

Enlarged Television Images

Editor, Science Questions and Answers:

Please answer this question Why don't inventors magnify the image on the modern small television screen with lenses placed before the screen (somewhat as a moving-picture film is magnified) and throw the image upon a larger screen? Or can't it be done?

Charles Bede, Jr.,
8145 Melville Avenue,
[redacted]it, Mich.

(Our correspondent's fundamental idea has already been utilized by television engineers, to the full extent that the limited detail of present television images will permit. It does not, however, reveal anything previously hidden; but only makes the image visible at a greater distance, and consequently to more spectators. To an eye which is too close to the magnified image, it becomes unrecognizable. If Mr. Bede will take a magnifying glass of considerable power, and examine with it one of the coarse newspaper "half-tone" reproductions of photographs, he will see a similar effect. Present-day television images are composed of points, from 576 to 4500 in number (or as many as there are in a section of newspaper half-tone from 1-3 to 5-6 of an inch square). Magnifying them does not add to their clearness; for the number of details possible to see is limited by the number of points that compose the picture. In the perfected television of the future, described by our authors, we must expect to find images of millions of points reproduced; to meet the demand of the human eye, with its myriads of sensitive "rods" and "cones" and its power of shifting the field of acute vision almost instantly.—Editor).

What Is the Velocity of a Magnetic Field?

Editor, Science Questions and Answers:

Will you, please answer the following questions?

(1) Is there any experiment for determining the velocity of a magnetic field away from the instrument which produces it? Please explain.

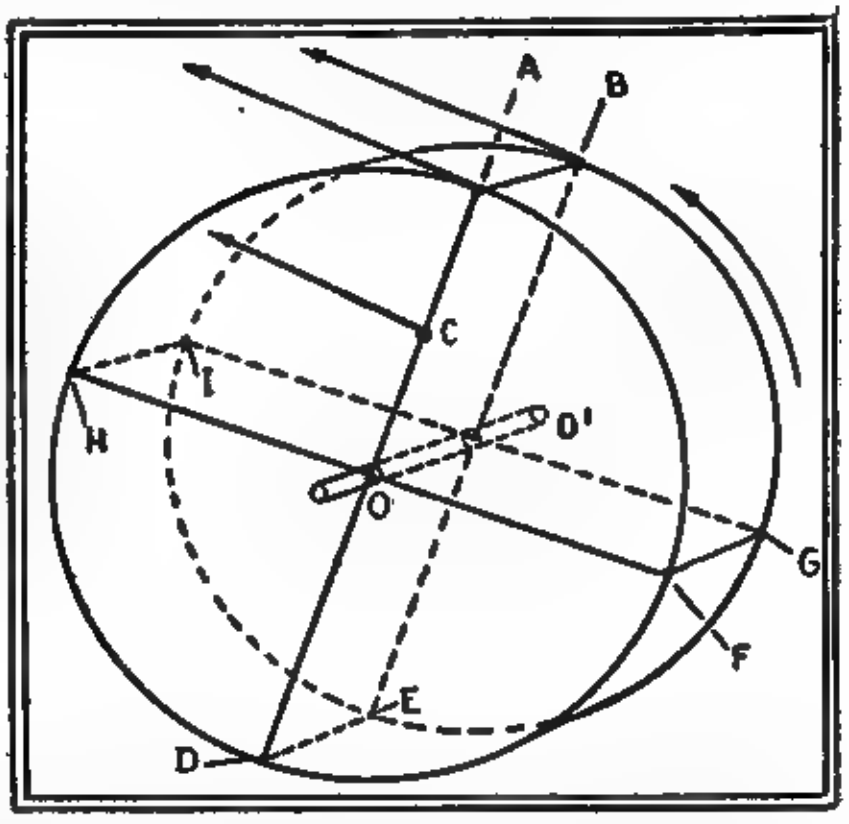
(2) If objects are shortened in the direction of motion, what happens to a rotating wheel?

E. Lazarus,
48 East 103rd Street,
New York City.

(1) A simple method is to measure the velocity of transmission of a radio "wave," which is really a magnetic field. For example, a [redacted]tion at New York sends out radio signals. These go around the globe in all directions. Now, by comparing the time taken by the waves to reach a station at London by the most direct way with that of a signal which has taken a longer route over the earth's surface, it has been found possible to determine the velocity of the waves and so of a magnetic field. It is nearly equivalent to that of light, 186,000 miles a second. For example, the waves travelling east to London the short way cover 3000 miles, and travelling the long way west go 22,000 miles. Now, if the difference in time between receiving the two identical signals is about one-tenth of a second we can easily see that it took 1/10-second for the waves travelling west to cover 19,000 more miles than on its eastward journey. The speed of the waves, therefore, would be around 190,000 miles a second. Very exact measurements have been made by automatic recording machinery, and give the result stated above; [redacted]adio is about as fast as light. Theoretically, the speeds are the same in vacuum; both light and radio are slowed up by the presence of material substances—such as the atmosphere.

(2) Shortening of objects occurs, to an appreciable degree, only as the velocity of "translation" approaches that of light—186,000 miles per second. Let us assume, in the accompanying figure, a rotating wheel, with the velocity of points on its circumference 186,000 miles per second. The direction of velocity of any point "A" at any instant would be as shown by [redacted] arrow. Another point "C", halfway between the axis and the circumference,, would have a speed only half that of light. Now, in order to answer the question (which is wholly hypothetical) we must consider a cylindrical wheel as it is—geometrically an infinite number of planes ABDE rotating about an axis designated by O-O'.

These planes are composed of lines like "A-B" (considering this line extended in the direction of vison.) Now, the line is moving in the direction of the arrow at the speed of light. According to the Lorens-Fitzgerald contraction theory, it should contract in the direction of motion, designated by the arrow. But, as the line has no length in the direction of motion, there will be no contraction.



Showing a rotating wheel, with points A and B on the circumference moving in the direction of the arrows with the speed of light. The wheel is composed of an infinite number of planes, of which BADE and FGIH are examples. As the planes are composed of lines such as the line AB, which have no dimension in the direction of motion, they do not contract.

Professor Samuel G. Barton, of the Flower Observatory, University of Pennsylvania, interprets the problem to mean that, since a wheel is made up of an infinite number of circles, each of which is composed of an infinite number of points, it is necessary to consider each point separately; and, because a geometrical point cannot shrink, there will be no contraction whatsoever.

Physically, however, the problem is absurd. No body can rotate fast enough to have its length affected, and still hold its particles together.—Editor.)

(*Continued on Page 861*)

The Reader Speaks

IN this department we shall publish every month your opinions. After all this is your magazine and it is edited for you. If we fall down on the choice of our stories, or if the editorial board slips up occasionally, it is up to you to voice your opinion. It makes no difference whether your letter is complimentary, critical, or whether it contains a good old-fashioned brickbat. All are equally welcome. All of your letters, as much as space will allow, will be published here for the benefit of all. Due to the large influx of mail, no communications to this department are answered individually unless 25c in stamps to cover time and postage is remitted.

Is Evolution a Fallacy?

Editor, Science Wonder Stories:

I just want to make a classification of the stories which have thus far appeared in Science Wonder Stories Magazine. I have created four classes: 1st, excellent—stories which will be remembered; 2nd, good—stories to be read over again. 3rd, fair—stories entertaining; 4th, poor—stories below mediocre.

First class: "Warriors of Space," by James F. Marshall; "The Alien Intelligence," by Jack Williamson; "The Menace from Below," by Hart Vincent; "The Eternal Man," by D. D. Sharp; "The Human Termites," by Dr. David H. Keller; "In Two Worlds," by Edward E. Chappelow; "The Stellar Missile," by Ed Earl Repp.

Second class: "The Reign of the Ray" by Irvin Lester and Fletcher Pratt; "The Making of Misty Isle," by Stanton A. Coblentz; "The Dominant Horror," by Dr. David H. Keller; "The Moon Beasts," by William P. Lecke; "The Radium Pool," by Ed Earl Repp; "The Feminine Metamorphosis," by David H. Keller. "The Onslaught from Venus," by Frank Phillips; "The Metal World," by Ed Earl Repp; "The Phantom Televiser," by Bob Olsen; "The Space-Dwellers," by Raymond Gallun.

Third class: "The Marble Virgin," by Kenneth McDowd; "The Threat of the Robot," by David H. Keller; "The Cubic City," by Rev. Louis Tucker, "The Ancient Brain," by A. G. Stangland, "The Green Intelligence," by Harley E. Aldinger; "The Cold Triumvirate," by Walter Kateley; "From Here to Earth," by Walter Kateley.

Fourth class: "The Diamond Maker," by H. G. Wells, "Into the Subconscious," by Ray Avery Myers.

Fortunately, the last class is not filled.

Now here is a real brickbat for you. You've been hungering for some, you say.

You actually insult genuine science, cast reflections on true science, by preaching the impossible doctrine of evolution. The world's greatest biologists and scientists of every kind have repudiated the theory of the evolution of man as false; and yet your magazine is aligned with all the pseudo-scientists who still believe in that ridiculous theory. That, chiefly, is the reason I placed "Into the Subconscious" into the fourth and last place in my category; because such stories insult the intelligence of thinking people.

You have accepted evolution as the following basis: say, a man came into court and claimed that all his evidence had been lost but that, if the evidence were found, he would be in the right. That is the basis on which you accept evolution. I challenge you to put forward just one irrefutable proof of your theory!

Otherwise your magazine is fine, as I have said before.

How about a sequel to "The Stellar Missile," by Ed Earl Repp, and possibly one to the "Human Termites," by David H. Keller?

I would like to hear personally from other readers of this magazine in regard to evolution, our greatest modern popularly-entertained fallacy.

Wallace Wardner,
Hobart, Oklahoma.

(Mr. Wardner's excellent classification of our stories is one of the best we have received. We unreservedly believe in the evolution of man from a lower species. The resemblance to the monkey family is too marked not to impress the discerning student. Of the evidence in support of the evolution of man, we might mention the discovery of the remains of prehistoric man in caves and in excavations. Such skulls as those of the Cro-Magnon man, Homo Neanderthalis, the Piltdown skull, and others point definitely to a human being existing ages ago, inferior to us in mental capacity and civilization, yet superior to the apes. The Field Museum of Chicago has just had reconstructed a scene of a prehistoric family at home in a cave. This reconstruction is made from actual remains. Our desire, however, is not to convince anybody for or against evolution. We believe in it and refer anyone seeking light on the subject to the many books on man's evolution.—*Editor.*)

Common Sense About Electrons

Editor, Science Wonder Stories:

I think that the greatest unknown mysteries of science are to be found in a simple reasoning rather than a complex system of mathematical study. Though I know very little about the complicated side of these things, I have always been interested in all things unusual.

The theory of matter as a mass of separate and individual electrons and protons, encircling one another at incomprehensible speed and of the same time adhering as a whole to make substances, doesn't appeal to me as common sense; although I cannot see an alternative other than that matter is just substances that can be divided and subdivided infinitely and contains potential energy.

A long while ago I read "The Moon Pool" by A. Merritt, and I never forget the wonderful wealth of imagination and romance in it. I tried lately to buy it, but was unsuccessful. Could you find out how I could obtain a copy?

I like Dr. Keller's stories and think he uses a fine line of thought in most of them. I also like Dr. Hawkesworth's stories.

I don't care for the Science News items and would like to see the space used for fiction. Don't start a readers' column in the Quarterly.

One thing, however, bothers me with our magazine; and that is the little subtitles or captions that appear throughout the story and always disclose the coming events. These, and also some illustrations, foretell parts of the story and spoil the tension throughout.

Your commenting on each story is a good practice, and it makes the theme of action more interesting and plausible.

Roy Braund,
2302 West 85th Street,
Cleveland, Ohio.

(This is a long bill of complaints, and it contains some interesting suggestions. Concerning the theory of atomic structure, some very great scientists have devoted their lives to working it out and establishing it. In some cases a complex mathematical proof and demonstration is the only kind available; but when these demonstrations are reduced to every-day language we discover they are quite simple. The electrons and protons do not encircle one another. Each atom has a nucleus, which contains all the protons and all the "bound" electrons. The "free" electrons circle around this nucleus as the planets revolve about the sun. If protons and electrons circled around each other indiscriminately, the result would be chaos. As it is, the theory of the constitution of the atoms seems quite common-sense.

Concerning the "Science News of the Month" sections, we find that the great majority of our readers are enthusiastic about it. This science news is one of our standard services to our readers. We obtain information as to the latest developments in science from about fifty different sources, all authoritative. In addition, we have the benefit of special news services that give us immediately the results of scientific investigations. It is our purpose to present each month the type of news which will enable our readers to keep abreast of the most important developments in science.—*Editor.*)

Humor in Science Fiction

Editor, Science Wonder Stories:

I have been your reader for quite some time and have never said a word. Now it is my turn to hurl a few brickbats and shrapnels—

A certain person criticized "The Cubic City" because there was more humor than science. I wish to answer the argument. If there weren't any humor in this world, this would be the most dismal place that could be imagined.

I appreciate and love the scientific trend of the stories in "our" magazine. But—variety is the spice of life! Don't forget that. Of course, there is such a thing as being too highly spiced. But you can't please everyone. You have to have *different* kinds of stories to please the myriad science-fiction fans.

I read one criticism on "The Cubic City." It was purely mathematical. Any one could see that. The criticism was *just*. Concerning the story, I wish to say that when a short story has a humorous ending once in a while, the humor provides just the proper touch. It is to effect the "grand finale" that we need. In view of all the scientific stories we read, we need a little humor now and then to give us some relaxation.

Somebody said "The Reign of the Ray" was "simply terrible." I take exception to that statement. Naturally, every person is most interested in his own chosen profession. Well, I am starting my thirteenth year in the U. S. Army. I have soldiered in six different countries. I believe my word should go at least half-way. As a soldier, I appreciated "The Reign of the Ray"; because the authors not only displayed mighty good science, but they also showed they were pretty well up on military tactics, and military science in general. My hat is off to the co-authors of "The Reign of the Ray." May their tribe increase! May their shadow never grow less!

Now the brickbat—I get gray-haired waiting for the next copies. Your Monthlies should be Weeklies and your Quarterlies should be Monthlies!

H. A. Sprinkle,
Sergeant Co. H, 9th Inf.,
Fort Moultrie,
South Carolina.

(Sergeant Sprinkle's defense of humor seems to be quite just. Even in a science fiction story, humor is not out of place. Some of the great tragedies of literature have a good deal of humor to provide the "comic relief." Humor gives balance to the story. More than that—it is an indispensable element of modern life; it was never more necessary than it is now.

The writer should accurately know his military science. If he says the authors of "The Reign of the Ray" know their tactics, he is not to be disputed.—*Editor.*)

Astronomical Impossibilities

Editor, Science Wonder Stories:

I am eighteen years old, and I have been a reader of science fiction stories for several years. These stories have aroused my interest in Science to such an extent that I became an active member of an astronomical society.

I want to congratulate you on the excellent name of your magazine. Any flight of imagination illustrated by Paul would not be a bit blatant. I am tremendously glad that you are getting out a Quarterly.

Now, as usual, after the flowers comes the Irish confetti. Is it not possible for you to step on the incorrect science, or in some way make it known that such and such a statement is wrong? In the October issue there were two glaring errors which could have been easily eliminated.

(*Continued on page 851*)

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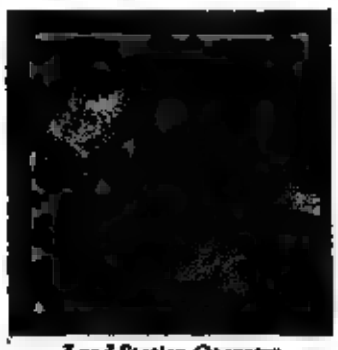

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Can Man Free Himself From Gravity?

(*Continued from Page 842*)

tician knows that the particle of matter at a given point and given time is subject to a *single* "field." The *analysis* of this field into gravitational, electrical, etc., is a *mental* process, not a process of nature. As our analyses proceed and become refined, we change our names and ideas.

I am surprised that Dr. Wolff did not mention Einstein. Many silly statements have been made about his theory, as, for instance that he has proved there is no gravity. What he really said amounted to the assertion that the paths of radiation rays are not Euclidean straight lines, but are curved; the bends coming in where "matter" is present. Gravitation is the bend. When we learn how to straighten these curves, we will have learned how to control gravity. Since matter is merely a form of energy, the problem is to find a form of energy which will produce the opposite curvature. There is no present development in modern physics which says this is impossible.

There have been many attempts to reduce gravitational effects to electric or magnetic forms; but these cannot yet be called successful. But the various "guesses" of physicists and mathematicians tend more and more to a "unitary" statement—including Einstein's latest—which means that from a single theorem about energy will be deduced all properties of matter and energy. When this is attained, we may hope to find a means of controlling gravity.

Of course the solution may turn out to be only in the ultra-microscopic realm inside the atom, or perhaps inside the electron. But, for the scientist, this would be a solution. He is not primarily concerned with its practical use. Perhaps, as Millikan is said to have stated, we may never be able to utilize intra-atomic energy; but the physicist is not worried by that. Yet when we remember that the remark of the physicist-mathematician, Maxwell, that all radiation is of one kind, is at the base of all modern radio development, we rather expect other theoretical statements to lead to practical results.

The unexplored universe is vastly larger than the explored. The radio-active elements have revolutionized chemistry, and mathematics is creating a new physics. Further, the whole territory of biological "f o r c e s" and psychological "forces" is the frontier of the scientist today. What powers lie here for humanity! In a matter of a few years when we know how to utilize them, we may expect many a "wild dream" to become, in some form, sober fact. As we know now, all of Nature's secrets are a piece of impudent arrogance.

Science News of the Month

(*Continued from Page 846*)

GENERAL

SHAPLEY INDEXES WHOLE UNIVERSE

Professor Harlow Shapley, director of the Harvard Observatory, has, during the past year, worked out a system of classification of all known systems of material bodies. The magnificent scheme embraces the whole material world, from the infinitesimally tiny protons and lectrons through the scale to star-systems "more than a thousand million trillion miles across" and on to the "space-time complex." This classification is comparable to the one made by Linnaeus in the field of biology.

There are seventeen major classes in the plan outlined but, "as a confession of ignorance and as a confession of faith" both ends are left open. In the infinitesimal scale there are seven minus quantities, ranging from corpuscles (No. 6) to molecular aggregates. Man is listed simply as a "colloidal aggregate of organic substances." Then the classification goes on through meteorology, the planets, the stars, galactic clusters, star clouds, super-galaxies, and other astronomical units, to the "cosmoplasma", which includes interstellar space, radiations, and diffused nebulae. The last item in the Universe is "the space-time complex." The new classification is expected to bring order out of chaos in scientific thought and in popular thought as well.

SKYSCRAPERS PLANNED AS UNIVERSITY CORES

Built of glass, copper, concrete, and steel, according to the plans of Frank Lloyd Wright, four new eighteen story edifices in Chicago will be in the shape of inverted conical pyramids. The mainstay of the structures will be a concrete core running through the centre of each, and around this core will be the body of the building itself. The inverted cone effect is to be produced by the construction of small abutments as a building rises, and the appearance of the whole will be that of an overlapping pyramid. The materials of construction permit of an exterior and interior beauty not obtainable heretofore.

SCIENCE AND RELIGION NO LONGER CONFLICT

Professor Kirtley F. Mather, head of the Department of Geology in Harvard University, has declared that the battle between science and religion is rapidly approaching a truce. "The scientists and the theologians are laying down their arms because they realize that warfare is neither scientific nor Christian. Instead, they are joining in the search for truth, each realizing the validity of the field of the other."

According to the professor, the origin of man can be explained without recourse to religion, but the existence of the highest type of man cannot be explained without it. "I don't see anything necessarily supernatural in the origin of man. It is perfectly logical to me that out of the inorganic things of the world emerged conscious living beings and that out of the conscious living beings, only yesterday in the geologic sense, emerged self-conscious man. But I do believe that there are spiritual values as well, operating in this physical world; and if these spiritual forces are law-abiding and consistent, the scientist has much to offer the man of religion."

NEW TIME-MEASURER RELIEVES DRUDGERY

Much of the wearisome routine work that now besets research workers will be taken off their hands by a new electrical robot described at the recent meeting of the National Academy of Sciences. The device is the invention of A. L. Loomis, banker-scientist of Tuxedo Park, N. Y., and has been given its first extensive try-out by Prof. E. N. Harvey of Princeton University. The mechanism is intended for the recording of natural rhythms, such as breathing, the beating of a heart, or the rapid impulses along a nerve trunk. It is geared in such a way that ten successive beats are recorded by a straight line drawn by a pen, the length of the line indicating the time of the action. Then the pen goes back to the zero line and starts recording another ten beats, on a line parallel with the first. The instrument will keep this up for hours or days on end, so long as ink, recording paper, and the pulsating animal or organ hold out. In the meantime the scientist who used to have to sit and watch his experiment through many weary hours can lecture to his class, play golf, or go home to bed.

URGES LABORATORY DEEP IN THE EARTH

Professor Harlow Shapley, director of the Harvard Observatory, has stressed the need for a great laboratory deep in the earth—deeper than man has ever penetrated before. The establishment of experimental and research workshops deep in the earth will add an invaluable amount of information to our knowledge of a dozen important fields of geophysics and astronomy.

Referring to the "third dimension in geography", Dr Shapley asserts that failure to study the interior of the earth beyond a small depth close to the surface leaves a very serious hiatus in scientific inquiry, and one which, if filled, is certain to yield information of great practical and scientific significance. By boring deep into the earth it might be possible to tap the earth's internal source of heat for utilitarian purposes. The laboratories will investigate the irregularities in the length of the day, and the pulsations of the earth's crust; the "thermo-gradient" of the earth and its bearing on the origin of the earth and its source of heat; the nature of the radioactivity in the rocks, and its variation with depth; and earthquake waves.

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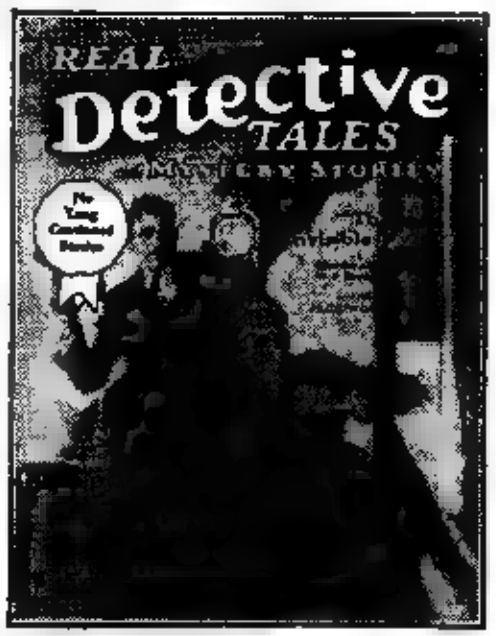

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The Reader Speaks

(*Continued from page 846*)

In "The Ancient Brain" Mr. Stangland says that the star Betelgeuse has ten planets. It is an M-type star on the giant sequence, and it is very rare and attenuated. Planets are born by tidal action produced by the close approach of another star (see Jeans' "Tidal Theory" and Chamberlin's "Planetesimal Theory"). As Betelgeuse is composed of a rare gas, it would be impossible to set up tidal action. Also there is only one chance in 500,000,000 that two stars would approach close enough to cause such a catastrophe, and that they would be of sufficient density to eject material that would condense into a solid.

In "From Eros to Earth" Mr. Kateley says that the scientist of Eros learned that Terra had an abundance of the heavier elements through the spectroscope. That is impossible; because the light that the Erosians analyzed was reflected sunlight, and consequently would show only the surface elements of the sun.

Harold Pewtherer,
215 Lowell Ave.,
Portland, Oregon.

(Mr. Pewtherer should remember that the action in "The Ancient Brain" occurs 10,000 years hence. Now, although astronomically ten thousand years is but an instant, Mr. Stangland may have been exercising his imagination on what had happened to this giant star. Although the chances of two stars approaching each other close enough to cause tidal action may be 1 in 500,000,000, according to the theories extant, the creation of our own solar planets occurred through just such a chance meeting.

Regarding the criticism of "Eros to Earth" what Mr. Kateley no doubt meant was an instrument to penetrate beneath the surface and reveal mineral deposits. Such a thing is far from impossible. There is no doubt that the term "spectroscope" is incorrect.—*Editor.*)

The Wonders of the World

Editor, Science Wonder Stories:

What are the seven wonders of the world? What is the eighth? Are there any that are considered the ninth or tenth?

I am writing below the stories I like best in the September to December issues of the SCIENCE WONDER STORIES.

"The Human Termites"—wonderful.
"The Onslaught from Venus"—good.
"The Metal World"—good.
"The Phantom Televiewer"—good.
"The Stellar Missile"excellent.
"The Conquerors"—wonderful.
"The Time Oscillator"—excellent.
"The Radiation of the Chinese Vegetable"—good.
"The Super Velocitor"—good.
"The Lost Martian"—good.

I like a humorous story once in a while. I like particularly stories of insects of giant size almost wiping man off the earth. Keep your artist Paul. He is great. I can appreciate that it is exceedingly difficult to draw good pictures of science fiction stories.

Kermit Lasch,
Elkhorn, Wisconsin.

(The "seven wonders of the world" is an expression referring to architectural and artistic triumphs of the *ancient* world; these were the Pyramids of Egypt and the Sphinx; the hanging gardens of Babylon; the Temple of Diana, at Ephesus, in Asia Minor; the statue of Jupiter Olympus, in the valley of Olympia, 12 miles inland from the southwestern coast of Greece; the tomb of Mausoleus, at Halicarnassus, in Asia Minor (from which we derive the term "mausoleum"); the Pharos, a white marble lighthouse at Alexandria, Egypt, built in the time of Alexander the Great; and the Colossus of Rhodes, a great bronze statue at Rhodes, at the eastern end of the Mediterranean Sea.

None of these wonders has any particular scientific value at the present time. There are other wonders of the world which are not, however, listed with the Seven; these include the Great Wall of China; Stonehenge (England), the Catacombs and the Colosseum, at Rome; the Mosque of St. Sophia at Constantinople; the Leaning Tower of Pisa, Italy; the Porcelain Tower of Nanking, China; the Vatican in Rome (the largest dwelling on earth, containing over 7000 rooms), and the Cathedral of St. Peter, in Rome, one of the great architectural triumphs of the world.—*Editor.*)

(*Continued on page 853*)

The Reader Speaks

(Continued from page 852)

Will Correspondents Give Their Addresses?

Editor, Science Wonder Stories:

I am a regular subscriber to your magazine, SCIENCE WONDER STORIES and wish to state that I find it intensely interesting. Personally I am very much intrigued by interplanetary stories. "The Onslaught from Venus" I like particularly well; but really it is difficult to single out any one story, as the majority of them are well done indeed. Every one has taken a "whack" at the covers; so I feel I should not neglect to remark that, far from being lurid or trashy, they are excellent and attractive!

Regarding your department "The Reader Speaks," in the December issue there is a letter from Ulysses George, Jr., asking for letters. I have written to him but, as he gives his address only as Ulysses George, Jr., San Francisco, Calif., I am wondering if same will reach him. Will he please get in touch with me?

Some time ago I wrote to a chap in Manchester England who requested, through your magazine, correspondents. Have made a very pleasant friendship by so doing, and am exchanging letters constantly that are proving of much interest mutually.

V. L. Judson,
P. O. Box 707,
New London, Conn.

(We are pleased to print Mr. Judson's letter in the hope that future correspondents will give their full addresses, so that interested readers may write to them. One of the functions of the "Reader Speaks" Department is to provide a common meeting ground for our "fans" and for the discussion of scientific opinions; and we want to promote their relationship as much as is in our power.—*Editor.*)

Helps Him in School Work

Editor, Science Wonder Stories:

Just a few words of praise before I criticize your magazine. It is wonderful. I cannot express my feelings toward it in words. Your publication has helped me greatly in my school work. It has helped me to understand the many sciences. I understood only a trifle of science before getting your magazine, but now I take the lead in my classes. I am good in Physics. Now I can understand the many difficult phases in that subject. What made it possible for me to do these things? SCIENCE WONDER STORIES.

Now for criticism: Why not make some of the good stories longer and, if a few short ones are submitted to you, leave them out until the next issue and put in their stead a good long one? I do not agree on having too many long stories going on at once. Get a story for about four issues; when that is finished, start another. I would like to see more stories on Chemistry and fewer on Biology. I would like to see some good continued stories by Dr. Keller, Ed Earl Repp, and Frank Phillips.

Fred Rauner,
841 Richter Ave.,
Scranton, Pa.

(We are always glad to hear from students and learn that our magazine is assisting them in their studies.

The controversy on the long and short stories is by no means over, and it will probably remain an open question for some time.—*Editor.*)

How to Bind Your Magazines

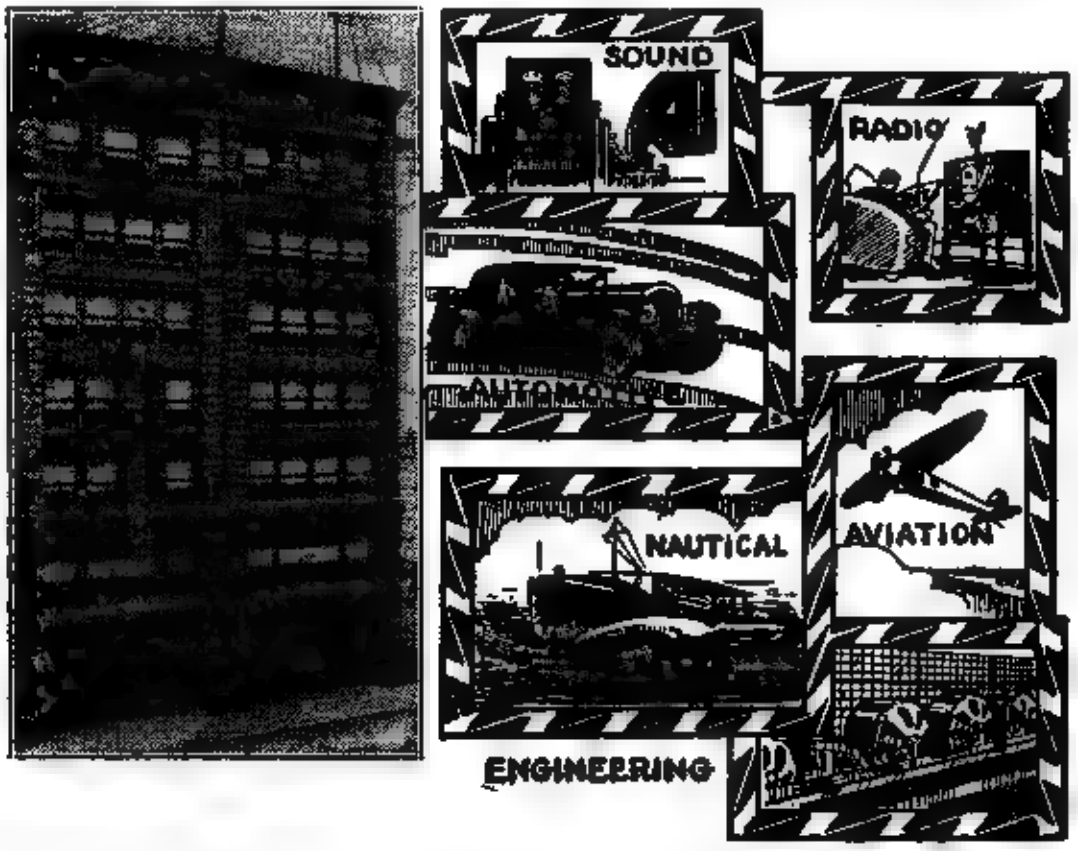
Editor, Science Wonder Stories:

Dr. Keller's "Human Termites" was certainly a great story. It's the best I've read for some time. From your explanation of the story on the first page, I was afraid that the remainder of the human beings on the plateau were to be wiped out, but I was pleasantly surprised. Incidentally, I wish to bring to your attention the fact that I have found out from a reliable authority that we are human *beings* and not "humans" as some of our authors insist. The ending of Dr. Keller's story left a pleasant taste in my mouth.

I don't like the authors who put their heroes into a utopia, or whose heroes invent something new and helpful to mankind, and then end their stories with ruin and destruction. "The Green Intelligence" by Aldinger is a recent example. I believe that there are better ways of ending a good story other than a hidden barrel of dynamite or a faulty electrical connection. It spoils it for me. Have the hero live, be rewarded—then write a sequel.

(Continued on page 855)

"ELECTRICAL OPPORTUNITIES"



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SEE PAGE 548
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4—WHEN THE SUN WENT OUT
By Leslie Stone

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The Reader Speaks

(*Continued from page 853*)

Recently I have bound all of my magazines for future reference and reading (I use them for both). I will describe my method for the benefit of others (although someone else may have a better idea.) It cost me just $1.35 to bind all the magazines I have collected since July, 1926. I have found that I can bind five magazines together and still read all the type in the middle of the third magazine with ease. I would suggest four as the best number, however. First, collect your magazines and divide them into books of four or five magazines each. Then measure the height of each book. Say it is 3 inches. Add to this 2 inches more, making 5 inches. Second, go to the nearest sheet metal shop and buy your binding. I found scraps of sheet copper, 5 x 12 inches, the best. Stop at a hardware store on the way home and buy a nickel's worth of ordinary pliable wire. When you get home mark each piece of copper (a nail is better than a pencil) with a line the length of the sheet one inch from each side. Next bend each sheet along these lines into a U shape with a hammer and vise. Now one should punch a hole near each end on both sides; a hammer and a nail will do it easily. Insert your book of magazines and continue the two holes through the magazines. A warning: be sure that the holes at either end are opposite each other. A nail will punch a hole through the magazines if nothing better is handy. Cut off a couple of pieces of wire about 4 inches long and push one through the holes at either end and bend it over.

Thomas Wayne McAdam,
1060 North Chester Ave.,
Pasadena, California.

(We print Mr. McAdam's letter, pleased to note the efforts he has made in behalf of his fellow readers. The scheme seems very practical. As to the happy endings in the stories, we invite the opinions of other readers on this disputed point.—*Editor.*)

Inertia and Gravity

Editor, Science Wonder Stories:

In referring to the "Super Velocitor" of last month's issue, it seems that Mr. Carpenter, in writing this story, has deliberately ignored the existence of two uniform and unchanging forces; namely, inertia and gravity.

Let us imagine a man equipped with a machine such as Mr. Carpenter describes. This man, after the machine is put into operation, takes, let us say, a dozen steps forward, and is then told to stop. But, can he stop? To be sure; he makes an effort by bringing both his feet to rest. But it must be realized that he has travelled this short distance at an incredible speed and, should he try to stop so abruptly, the momentum of his forward motion must surely cause him to turn a dozen somersaults in the same direction.

Enraged at this occurrence he springs to his feet; but, does he get on his feet? Certainly not. The terrific speed with which he arises carries him off the ground and upward to a height of, let us say, thirty feet. After his upward movement is retarded, he starts descending. But just what is the rate of speed of his descent? It is plain to see that his superhuman strength, which enables him to move at such tremendous speeds, can have no possible effect on his movements while he is off the ground. He must surely, then, descend at the same rate of speed as would be the case were he not affected by the "velocitor"; which means, in the first place, that it must take the equivalent of at least several hours in his time for him to descend, and in the second place, that he must immediately become visible to anybody until he reaches the ground. Indeed, he would even find it quite impossible to walk; for each stride would unquestionably send him off the ground after which he would necessarily encounter the same difficulty in returning.

Let us take another instance. Let us suppose, what most certainly should not be supposed, that these difficulties have been overcome and he is able to walk quite easily. What would happen if, while walking, he should accidentally kick a pebble at his companion who is standing still? Since a car travelling at a speed of forty miles per hour seems, to one equipped with the velocitor, to show almost no motion, then it can be readily seen that a pebble, which seems to be travelling at a goodly speed even to one equipped with this machine, must surely be

(*Continued on page 856*)

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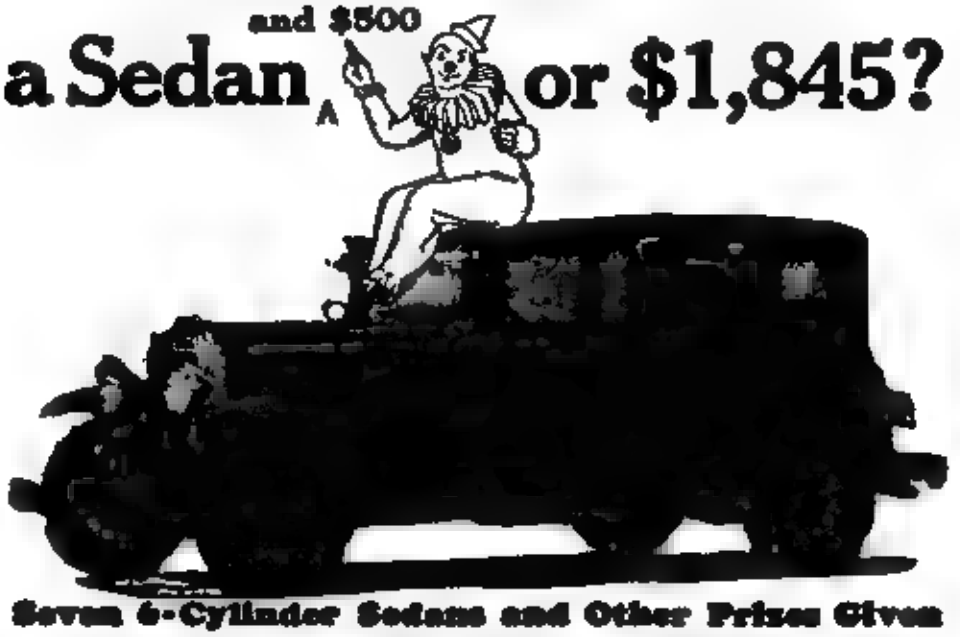

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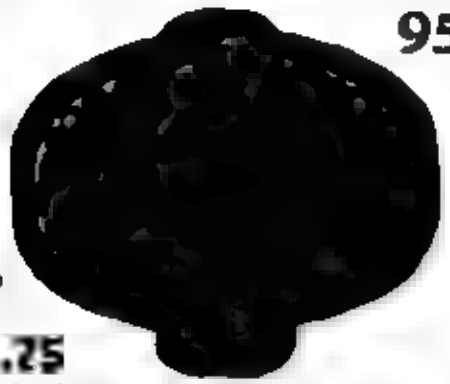

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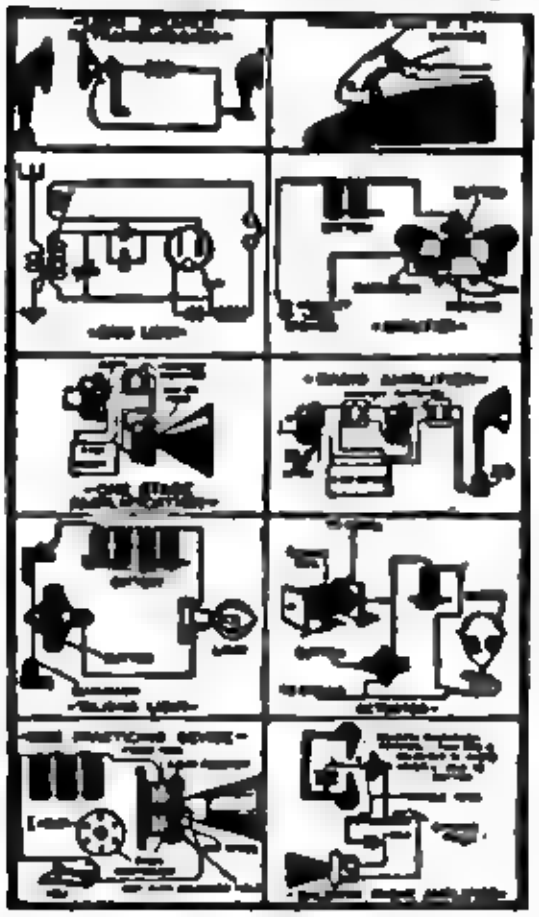

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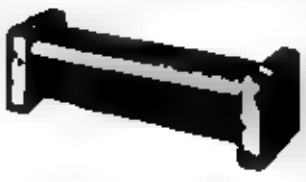

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The Reader Speaks

(Continued from page 855)

going through space at an enormous rate. This being the case, the pebble must undeniably pass through this unfortunate individual with more ease than a machine-gun projectile.

There are countless other situations which must occur during the practice of this proposed scheme of acceleration which would render it impractical; and indeed, unless these difficulties can be overcome, the whole idea may be called impossible. Mr. Carpenter, however, is to be congratulated upon the most excellent manner in which he has dealt with the subject. I, for one, must frankly admit that I have not read a more interesting story in a long time.

Max Jaffe,
149 W. Fourth St.,
Mount Vernon, N. Y.

(There is a great deal in what Mr. Jaffe says concerning momentum and inertia. However Mr. Jaffe should remember that everything that the people said and did in the story was in accordance with the new state of their sensations. In other words, if one of the men was told to step, what seemed to him as a normal distance to step in would to us be quite a great distance. For the senses of time and space of people under the influence of the velocitor were all in harmony. It was as if they existed in a world different from our own. However, we are glad to get them interesting and thought-provoking comments. The "Super-Velocitor," in our opinion, was an excellent story.—*Editor.*)

The Atmosphere of Eros

Editor, Science Wonder Stories:

I have just finished reading my first copy of Science Wonder Stories. I have found it thoroughly entertaining. It contains some very good material. There are, however, a few matters which seem a little vague to me. I would like very much to be enlightened concerning these things.

In the story in the October number, "Eros to Earth," I take it that the inhabitants of Eros were living under the normal conditions of the aforementioned asteroid. Eros, being so small, would have little or no atmosphere. Then, would it not be impossible for these people to live on Earth under normal conditions? Would it not be disastrous to them to have 15 pounds air pressure per square inch on them whereas on Eros they had no pressure above them?

Eros would have hardly any gravity, due to its size. Would not these people experience great difficulty in moving around on Earth, where the gravitational pull would undoubtedly be many times that of Eros?

Arthur H. Bunn,
5129 Drexel Boulevard,
Chicago, Ill.

(When an author's story is criticised on scientific grounds, we allow him to make his own defense. Mr. Keasley's explanation of air pressure and gravity on Eros, we append below.—*Editor.*)

The Author Speaks

Answering Mr Bunn's question regarding the inhabitants of Eros living under our atmospheric and gravitational conditions, I would say that it does not appear to be at all impossible.

As regards what atmospheric pressure there is on Eros, there is a wide range of possibilities.

The little planetoid may have an atmosphere many times deeper than that of our earth, which is very thin. The thickness of our envelope is roughly comparable to the thickness of the tissue paper that wraps an orange.

Scientists still debate some of the laws that govern the amount of atmosphere possessed by planets.

Our satellite the moon appears to have no atmosphere. Some of the planets are believed to have little, if any.

Observations by Huggins and Vogel have led to the conclusion that Uranus and Neptune have deep and dense atmospheres.

The gravitational pull on the inhabitants is of course governed by the law: every particle of matter in the universe is attracted toward every other particle, directly as the product of the masses, and inversely as the square of the distance between them.

It is the assessment of scientific opinion that there is a very dense core within the earth, made up of nickel-iron, presumably in a molten state. This core is many times heavier and denser than the outer layers of soil, rock, etc.; and is the part that accounts the major portion of the pull on the earth's surface.

(Continued on page 857)

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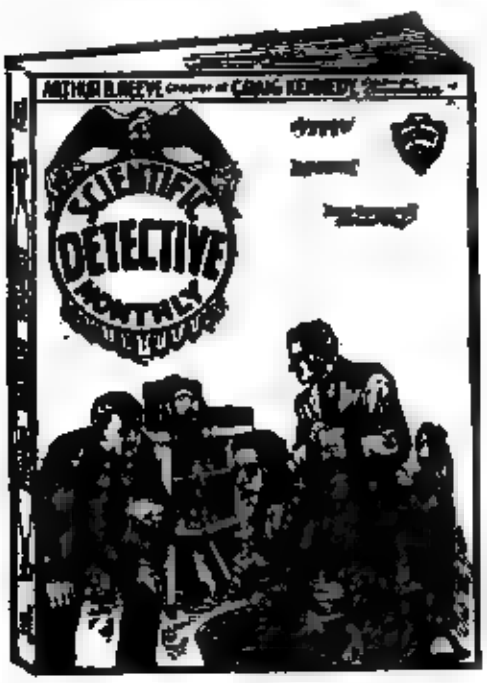

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The Reader Speaks

(*Continued from page* 856)

Consulting diagrams after Williamson and Adams, it appears that this core is estimated at approximately eighteen hundred and eighty-five [illegible] from the surface.

Suppose Eros also has such a nickel-iron core, much larger in proportion to its size; say only a few hundred feet from the surface.

Thus an equation might be such as to reassure the reader that the little people would suffer no discomfort while among us.

—WALTER KATELEY

Denies He Is a Sheep

Editor, Science Wonder Stories:

I notice in a recent issue of our magazine, a letter from a woman reader criticising all admirers of Dr. Keller as sheep. I am an ardent devotee of Dr. Keller; but I have never considered myself a sheep.

Dr. Keller, from my viewpoint, is a genius. His stories have a literary appeal lacking in most of your writers. In "The Human Termites" he attains heights approached only by "The Moon Pool" and "The Master-Mind of Mars."

I fail to see any cause for praising the "Radium Pool" so highly. It was a very good story in its way, but undeserving of the praises coming from so many readers.

I have said my say, and shall leave the stage, giving a final toast to you and to SCIENCE WONDER STORIES "the magazine of the century."

George Barbour
1719 W. 10th Street,
Oklahoma City, Okla.

(As we remarked when we printed Mrs. Ammons' letter, we make no attempt to influence our readers. We are guided by their likes and dislikes. No one can say they are guided by ours.

Mr. Barbour, in taking exception to being called a "sheep", states the feelings of many others. Dr Keller, we believe, had to be a good writer to get the admiration of thousands of our readers.—*Editor.*)

From a Competent Judge

Editor, Science Wonder Stories:

I am writing this: firstly, because I am egoistic enough to imagine that I am the world's most competent judge of Science-fiction, having read almost every story of that type that has been published since the beginning of this century, and, secondly, because I would enjoy giving a self-proclaimed connoisseur's opinion of several stories that have been more or less under fire since their appearance in your most excellent magazine.

The stories follow:

"The Alien Intelligence"—Good story.

"The Human Termites"—Excellent.

"The Radium Pool"—Can't get steamed up over it; like Repp.

"Warriors of Space"—Bad ending; astronomical errors.

"Onslaught from Venus"—Enjoyed this one.

"Menace from Below"—Haven't read it yet, like author.

"Boneless Horror"—Clever. You can't beat Keller.

"Moon Beasts"—Different; entertaining.

"Reign of the Ray"—Haven't read it; like authors.

"Threat of the Robot"—Rather pointless.

"Making of Misty Isle"—A fine writer's worst.

"The Marble Virgin"—A story I *liked*.

"Feminine Metamorphosis"—Rather slow.

"Eternal Man"—Grotesque.

"The Cubic City"—Read this twice; unusual for me.

"The Diamond Maker"—Good old Wells at his best.

Stories not yet criticised:

"The Metal World"—Good.

"The Ancient Brain"—Liked.

"Into the Subconscious"—Interesting; well written.

"Eros to Earth"—Enjoyed this one.

"In Two Worlds"—Too long getting started. O. K.

In the November number:

"The Stellar Missile"—Very good.

"The Space Dwellers"—One of the best I've ever read.

"The Problems of Space Flying" was fine; hope to see more space-flying articles.

"Science News" and "Questions and Answers" are total failures as far as I am concerned; give us a reprint in their stead.

(*Continued on page* 858)

Would *this* law let you marry?

Many States are quietly passing Eugenics laws. They are trying to protect innocent women from a living death with weak, puny, run-down males who have no more principle than to bring offsprings into this life to face the taunts, sneers and ridicule of associates, so these States tell them.

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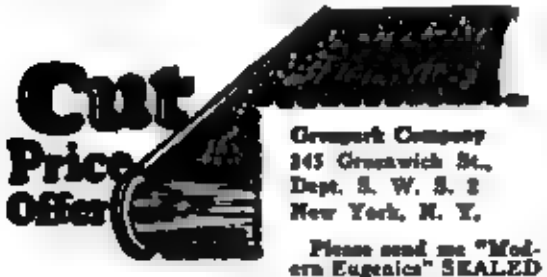

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The Reader Speaks

(Continued from page 857)

"The Shot into Infinity" and "Hidden World", in the Quarterly, were wonderful, especially the latter.

Some suggestions for reprints:

"Messiah of the Cylinder"—by Victor Rousseau.

"The Blind Spot"—by Austin Hall and Homer Eon Flint.

"The Metal Monster"—by A. Merritt.

"Through the Dragon Glass"—by A. Merritt.

"The Cosmic Courtship"—by Nathaniel Hawthorne.

"Draft of Eternity"—by Victor Rousseau.

"Land of the Central Sun"—(Author unknown; pub. 1904-05?)

Harry Owen, Jr.
4947 No. Troy St.,
Chicago, Ill.

(Mr. Owen's excellent analysis of our stories is one of the best we have received. His thirty years of science-story criticism qualify him for the task he has chosen for himself. His suggestions for reprints are unusually good. We would like to receive other such criticisms of our stories.—*Editor*)

Perhaps There Is a Sequel

Editor, Science Wonder Stories:

I am writing for the first and last time to "The Reader Speaks." I want to express my great disappointment on the concluding chapters of Mr. Keller's otherwise very interesting and thrilling story, "The Human Termites." This last installment does not tell what happened to the intelligence of the American nation in the Rockies. It does not explain why the White Ants did not contract some dangerous diseases when they devoured the human race. Most of the other stories are really very interesting. Please keep Wells and Verne out of our magazine. Their stories are antiquated. E. R. Burroughs is good for a reprint or two.

Harry Rinkin
1154 Washington Ave.,
New York, N. Y.

(The termites did not contract diseases when they devoured diseased human beings because the disease organisms were not strong enough to affect them. The bubonic plague that killed them off was intensified ten times by the gathering. As to other diseases, some forms of life [illegible] them.

Perhaps Dr. Keller will explain the doubtful points. We may persuade him to write a sequel to "The Human Termites."—*Editor*)

Human Cells Once Independent

Editor, Science Wonder Stories:

I want to say after reading the November issue of Science Wonder Stories that I enjoyed it very much.

I thought that the best story was "The Space Dwellers." Both the "Stellar Missile" and "The Green Intelligence" were very good.

The last installment of "The Human Termites" was as good as the previous installments. The idea contained in the story was exceptionally good. Needless to say it is unique. I don't remember ever seeing a similar plot in any science fiction story.

Before I saw the story I had had an idea somewhat similar to that. Namely that possibly the cells in the human body were once much more independent than they are now. Maybe entirely independent. Little by little they became more and more specialized until they made one entity. Possibly, I thought, the world will eventually become highly specialized like the cells of the body are now. Naturally when I read the first installment of "The Human Termites" I was greatly impressed.

Since you seem to be fond of classifications I will give mine. The best stories published in Science Wonder Stories are: "The Human Termites," "The Onslaught from Venus," "The Space Dwellers," "Into the Subconscious," "The Warriors of Space," and others.

The cover for the November issue is superb, by far the best one yet. I am in favor of cover contents such as this one, but I greatly prefer long stories to short ones provided of course that they are good. In a long story the author has more chance to awaken human interest in the hero. The more interest the better the story.

Jack P Sickels
Sapwai, Idaho

(Continued on page 859)

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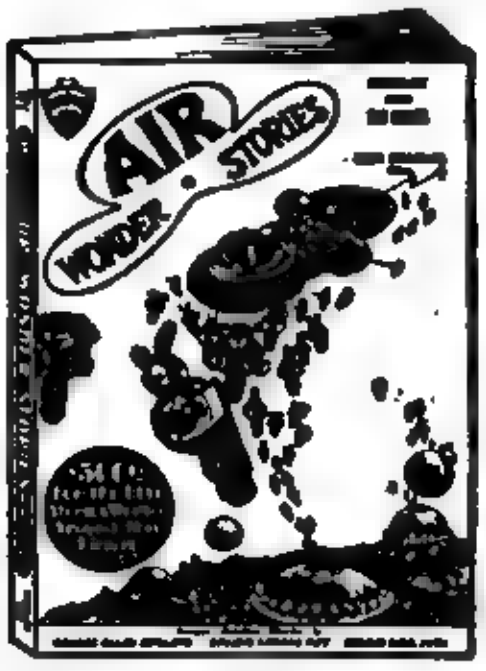

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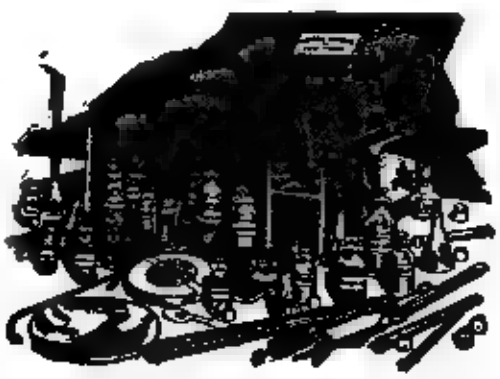

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The Reader Speaks

(*Continued from Page 858*)

(You are quite right. Man, like the other complex animals, evolved from the original unicellular source of life. There are some examples of this form of life still in existence—as the amoeba. In this form of life all the functions of the organism—eating, digestion, motion—take place in the one cell. The development of special cells for special functions represents a great forward step in evolution. The protozoa, one-celled animals, developed vacuoles for food and motion; these vacuoles developed into other cells. As time went on each cell developed its own function until to-day we human beings represent very complex mechanisms with thousands of very specialized parts.—*Editor*)

IF you are a lover of science fiction, you must certainly obtain the February issue of AIR WONDER STORIES, now on all newsstands. This magazine specializes in science fiction in which aviation of the future is featured. You will find here your favorite authors in stories as stimulating and exciting as those in SCIENCE WONDER STORIES.

Contents of the February issue are:

"The Flying Legion"
by George Allan England
"The Vanishing Fleet"
by Henrik Dahl Juve
"The Red Ace"
by Eugene George Key
"Liners of Space"
by Jim Vanny
"Berlin to New York in An Hour"
by Max Valier

An Old Friend

Editor, Science Wonder Stories:

I call you a friend because I've read your articles and publications as long as I can remember, and expect to read them until either they or I do not exist any longer.

The little scientific education I possess came from your magazines, and all the experiments I ever tried were directed, unknowingly, by you. Therefore, though we have never met, I hope I do not presume too much by calling you a friend.

At the present time I am conducting an experiment and am failing in it because of my limited education. I am experimenting with all kinds of *light rays* and I have tried unsuccessfully to produce an *infra-red ray*. I just must make this so-called "red ray" and would be very thankful if you would tell me how to do it, if possible, or tell me what books I could buy that will explain this red ray to me.

Please help me on the subject of the infra-red ray. You do not know how much I will appreciate it.

Emil J. Toerck,
469 Highland Ave.,
Clifton, N. J.

(It is a pleasure to receive so friendly a letter from an old reader who pledges lifelong allegiance to us. We can only say that we shall try to be worthy of this trust in us.

As to the infra-red rays, they are thrown off by bodies heated to a low temperature, often together with light, as in the case of an electric or a hot iron heater. It must be remembered that the infra-red ray cannot be seen; so this name is given to those vibrations whose wavelength is longer than that of visible light. Thin sheets of hard rubber, and some other substances, will cut off the visible light and pass the infra-red ray. This has been used to produce "noctovision," or television without visible light, and for special photography, as of the planet Mars.

The infra-red rays are really heat rays, and their presence may be detected by their heat-

(*Continued on Page 860*)

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The Reader Speaks

(*Continued from page 859*)

mum effects on a bolometer (an instrument for the measurement of minute differences of radiant heat by changes in the electric resistance of a blackened conductor exposed to it). So, in general, you can detect infra-red rays by the rise in the temperature of the body receiving them.

For information, you may consult Webster, Parwell, and Drew's *"General Physics for Colleges"* (The Century Company). A more specific treatise is *"Wave Mechanics"* by H. F. Biggs (Oxford University Press.)—*Editor.*)

More About Fakirs

Editor, Science Wonder Stories:

I noticed in the October issue of SCIENCE WONDER STORIES a question as to how the East Indians could levitate themselves; and as the editor does not seem to have given a satisfactory reply, I am butting in with a few words.

The only Fakirs capable of the art are Yogis. There are many kinds of Yoga, a word meaning "union." It is a practical science of physical, psychic, and spiritual development.

As to the situation: There are two forces in gravitational laws—attraction and repulsion. Since all matter is electrical in its composition, it obeys the electrical law that unlikes attract and likes repulse.

IF you have not as yet seen the Winter 1930 SCIENCE WONDER QUARTERLY,

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by Lilith Lorraine
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by Capt. S. P. Meek, U.S.A.
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Since the earth is in its relation to man is positive, and man is normally negative in his physical polarity, he is bound to the earth. By changing his polarity to positive he is repulsed by the earth, creating the phenomenon of levitation.

The Yogis do this by breathing exercises and rhythm. They do it also by sustained vibration of the body, which polarizes atoms, molecules, and cells in one direction.

Their breathing exercises make of their bodies a great magnetic battery. Electricity is all around us in the air we breathe. Air breathed in is charged either positively or negatively according to the nostril used. Breathing through the right nostril is electrically positive. It warms the body. The left nostril acts in the opposite manner.

A proper understanding of the subject can only be gained by a study of Raga Yoga. One good book on the market on these lines is "Vedanta Philosophy or Raga Yoga," by the *Swami Vivekananda.* ($2.00). It can be bought in any occult book store or at the Theosophical Press, Wheaton, Ill.

Levitation can also be produced in a conscious state. The subject does not have to be in a cataleptic state.

C. R. Ridmour,
P. M. Str. No. 19,
Ludington, Mich.

(Regarding this phenomena, we maintain a scientific suspension of judgment. We do not declare it is impossible, but like our attitude about spiritualistic phenomena, we would like to see it once. We are open-minded on the question, but would insist on a rigid scientific proof of this type of levitation.—*Editor.*)

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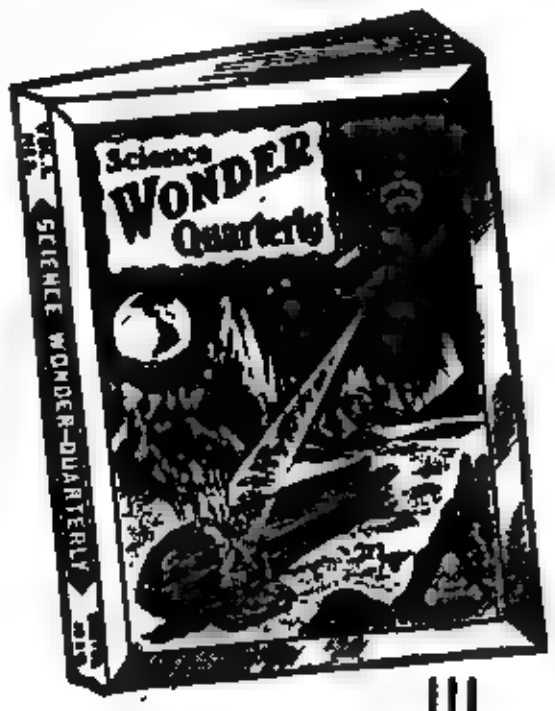

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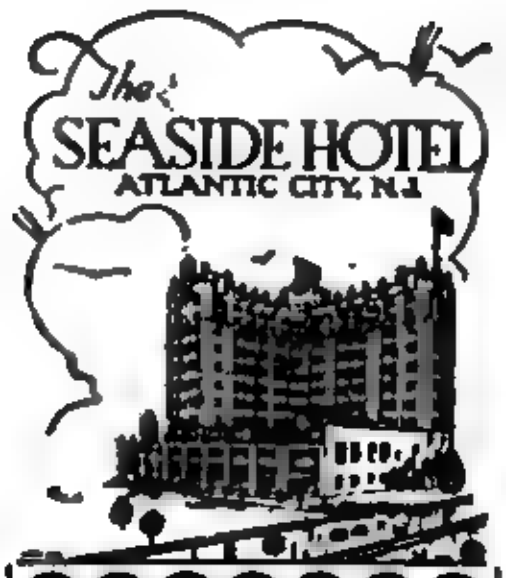

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Science Questions and Answers

(Continued from page 847)

The Stars and the Galaxies

Editor, Science Questions and Answers:

I have heard so many different definitions and explanations of these that I have become much confused. Will you please define for me

Cosmos?
Galaxy?
Universe?

(2) I heard that stars do not have much gravity; that is why they are so irregular in shape. Is this true?

(3) What would happen if a star were to be removed from the heavens, bodily?

Queens City Laboratories II
Kent, Washington.

(The term "cosmos" is used to designate the aggregate of all material in existence. Thus it includes everything that can be conceived of in our own universe and in space. It includes also those universes which we cannot see, but which may exist beyond our vision or calculations.

"Galaxy" is a term used to designate a group of stars, such as our own "Milky Way," of which our solar system is a part. This galaxy shows itself as a band of small stars—"star dust"—encircling the sky like a celestial equator. It contains many star-clusters and nebulae.

"Universe", in astronomical terms, means a great grouping of stars and galaxies of stars. It is usually so defined because it is separated from other universes by distances of hundreds of millions of light years. The Great Nebula in Andromeda is such a universe. Our Milky Way is part of a universe. For further information, see Page 541 of the November issue of SCIENCE WONDER STORIES.

(2) The apparent irregularity of bright stars, which seem to have points or rays, is caused by the interference of our atmosphere, through which we look at them. A somewhat similar effect will be seen by observing a street light through the meshes of a wire window screen. Gravity has nothing to do with this; all stars are almost perfect spheres.

(3) A star can not be removed bodily from the heavens, for there is no place to put it. It may become dark, or be destroyed by a collision, or an explosion; but its matter would still remain. However, if such a catastrophe should occur, because of the enormous distances separating stars, it would not be observable by ordinary means. The gravitational influence of our own sun, huge as it is in our solar system, would be practically impossible to detect at a fraction of the distance to the nearest star. —Editor.)

The Weight of a Body After Death

Editor, Science Questions and Answers:

I would like to find the answer to a question, which greatly intrigues me, as I have heard numerous arguments from both sides. When a person dies, does his body become lighter or heavier after death? Why?

William Dukstein,
2020 McKinley Ave.,
Lakewood, Ohio.

(There is no literature on this subject, but the New York Academy of Medicine states with authority that there is absolutely no change in the weight of a body at the moment of death, or a moment after it. The investigation of a number of cases has proved this point.—Editor.)

Light Velocity

Editor, Science Questions and Answers:

1. Do the component parts of a sunbeam—the colors from violet to red—vary in directional velocity or only in their rate of vibrations? That is, if the light of the sun were shut off in an eclipse, would the red rays be the last to reach us, and when the sun shone forth again, would the violet rays reach us first?

2. Is the speed of light the same in glass, or air, as it is in a vacuum?

W. E. Wilson,
Natchez, Wash.

(1 and 2. In a vacuum, the speed of the different colored rays is uniform at a rate which is approximately 186,000 miles a second; the same is true of all electromagnetic radiation, such as radio waves. However, the speed of radiation is affected by the density of any

(Continued on page 863)

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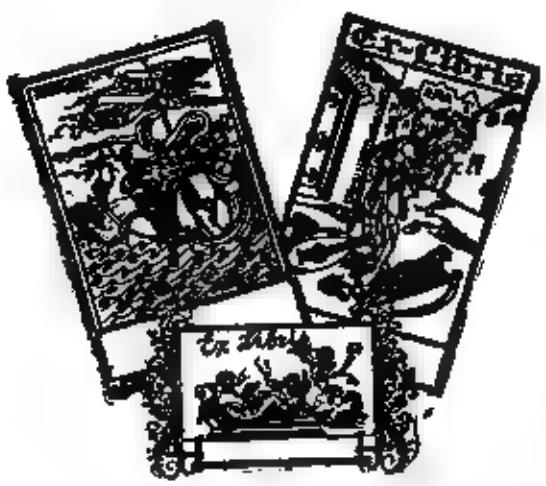

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Science Questions and Answers

(Continued from page 861)

medium through which it passes. Its maximum is in a vacuum, slower in air, and still slower in water or glass. This causes the separation of sunlight into its constituent colors when it passes through a prism or lens. As the space between the sun and the earth is practically a vacuum, except for our atmosphere, all the sun's rays reach us together. However, as it is the edge or "limb" of the sun which disappears last in an eclipse, we see only the sun's atmosphere and the red flames above its surface after the rest of it has disappared behind the moon. This causes a color change at the last instant.—Editor.)

Speed and Visibility

Editor, Science Questions and Answers:

According to Einstein's theory, objects decrease in size as they increase in speed. Hence, if you were in a space car going 100,000 miles a second, you would have decreased over half your original size. What would happen if you increased the speed to the speed of light (186,000 miles a second)?

C. W. Shipley,
Scranton, Pa.

(According to the Lorenz-Fitzgerald contraction theory, the length of a body traveling with the speed of light would contract to zero in the direction of motion. This theory depends upon the consideration of light velocity as constant.

In the Lorenz-Fitzgerald formula,

$$L_1 = L \times \sqrt{1 - \frac{V^2}{C^2}}$$

when V refers to the speed of a body and C represents the speed of light. L is the original length of the body, and L_1 is the new length at velocity V. Working out the problem, we find that when V = 100,000 L_1 = 0.58 L or a contraction of a little less than one third. When the body moves with the speed of light, we have L_1 equal to the square root of 1 minus 1, which is zero.—Editor.)

About Atoms

Editor, Science Questions and Answers:

Here are some questions that I would like to have you answer for me.

1. If an atom has never been seen, how is it known that there is such a thing?

2. What is the shape of an atom? (I mean is it like our solar system, or is it like a ball with the nucleus and electrons in the center? All the stories you publish that deal with atoms leave this part unexplained.)

3. How wide are the supposed canals on Mars judged to be?

H. Bugg,
1374 E. 32 St.,
Oakland, Calif.

(1) The existence of the atom was first deduced from the behavior of matter. Water, for example, is known to be composed of hydrogen and oxygen. Now, a molecule of water is the smallest amount of water that is possible, yet this molecule contains both hydrogen and oxygen. It was decided, therefore, to call the units of hydrogen and oxygen that make up water, atoms. In a molecule of water there are two atoms of hydrogen and one of oxygen.

(2 The shape of an atom depends, of course, upon its structure. Scientists are agreed that the atom contains a nucleus, which contains all the protons and the "bound" electrons—those electrons which are not free to revolve. The part of the atom around, and external to, this nucleus contains the "free" electrons. In shape the atom may be regarded, for practical purposes, as a sphere with the nucleus at the center and the free electrons revolving inside the surface of the atom itself.

(3) The "canals" of Mars are known to exist, and they have been photographed, but whether they are canals in our sense of the word, or merely surface markings indicating dead river beds or some other phenomenon we cannot say. The width of these canals varies; the latest measurements of Dr. Lowell indicated that they are nowhere over 15 or 20 miles wide, nor less than 2 or 3.—Editor.)

BOOK REVIEWS

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Throughout the volume are photographs of the heavens taken through the world's greatest telescopes; the hypothetical drawings of the atom and its moving particles. This book will reward every attentive reader with a comprehensive view of the wonders of modern science.

THE RIDDLE OF THE UNIVERSE, by Charles Ludvigson. 59 pages, stiff cloth covers, 8" by 5¼". Meador Publishing Company, 27 Beach Street, Boston, Mass. Price $1.25.

This book is a psychometric study of the Universe, as well as an exposure of the Relativity Theory and other hypotheses. The author, who disagrees with Professor Einstein, whose Relativity Theory, "under a flash cover, occupies a large territory in science," does not, in this book, attack the great German scientist. Rather, it is an earnest expression of the author's search for the truth of the theories involved.

A detailed study of Einstein's hypotheses, and of the galactic plane, reveals many defects in the fundamental and basic structure of the theory, according to this author.

Ludvigson maintains that Professor Einstein has failed also in another angle of the theory of relativity; in that he does not comprehend the objective function of the ether, or the discrepancy between reality and reason. As a result, according to the author, Einstein robbed the Universe of the ether.

PATENT LAW FOR THE INVENTOR AND EXECUTIVE, by H. A. Toulmin, Jr. 288 pages, size 8" by 5½", stiff cloth covers. Published by Harper & Brothers, New York. Price $4.00.

This highly informative book by a well-known patent lawyer—a member of the firm of Toulmin & Toulmin—presents the practical knowledge gained as the result of years of successful practise in a specialised field of the law. The author, keeping in mind the needs of the inventor, shows clearly how the creator of a new scientific device can protect his interests against those who are on the alert to take advantage of his ignorance of legal procedure. At the same time, he gives valuable information for the manufacturer himself, who, once, he has purchased the rights to a patented article, must be careful in his use of the patent he has paid for.

THE SOURCES OF A SCIENCE OF EDUCATION, by John Dewey. 77 pages, stiff cloth covers, size 7⅞" by 5". Horace Liveright, New York. Price $1.50.

This new book by Professor Dewey, considered America's greatest philosopher, is the first in the series to be issued by Kappa Delta Phi, an International Honor Society in Education. The volume makes a decided advance in modern educational theory, in that it presents education as a science among other sciences. Explaining the relationship between philosophy, psychology, biology, economics, and the new science of education, Professor Dewey makes a plea for the placing of education on a basis strictly scientific.

ANTS, BEES AND WASPS, by Sir John Lubbock, F.R.S. 377 pages, illustrated, stiff cloth covers, 8¾" by 5¾". E. P. Dutton & Company, New York. Price $3.75.

This famous book, based on the seventeenth edition, and edited and annotated by J. G. Myers, F.R.S., is a standard work in its field. It is, broadly speaking, a record of observations on the habits of the social *hymenoptera*. The volume contains the record of various experiments made with ants, bees, and wasps during the ten years between 1872 and 1882; yet so excellent was the work of the author, that his conclusions, now almost half a century old, are still accepted by entomologists as standard and as accurate in every detail.

THE INVISIBLE WEB, by H. Ashton Wolfe and Edmond Locard, with illustrations from photographs taken from official records. 248 pp. New York. Frederick A. Stokes Company. $2.50.

This book contains ten episodes gleaned from the police archives of Lyons, France. The fact that the crimes are from real life does not in any way detract from the absorbing interest of the book. Mr. Ashton-Wolfe and Mr. Locard are internationally known criminologists. Mr. Ashton-Wolfe tells the stories with the fascination of fiction; they are by no means a monotonous recitation of the scientific formulae used in the detection of the criminal. He builds a dramatic structure around the incidents that grasps the attention of the reader at once. The solutions of the crimes are arrived at by reasoning after the manner of Sherlock Holmes. As a matter of fact, the author, in his foreword, credits Mr. Conan Doyle with having awakened the police of foreign countries to the great possibilities of the methods of his well-known character. Yet, he states, the science of crime detection is very ancient. Our ancestors ancestry—not to mention the more recent, but almost as primitive American Indian—had a keener natural sense for tracking down evildoers than we of today. Footprints, depressions in the earth and grass, a broken twig, etc., were all significant to them. Yet science and organization makes the possibility of bringing the criminal to justice greater than ever before. At times the stories become slightly grewsome in their details; but this may be pardoned as unavoidable and necessary in following step by step the deductions arrived at from the clews presented to the investigators.

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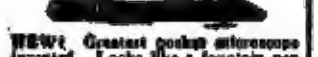

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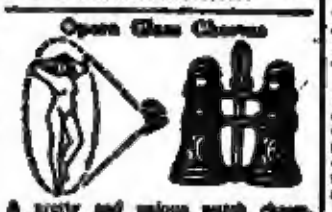

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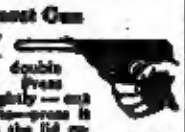

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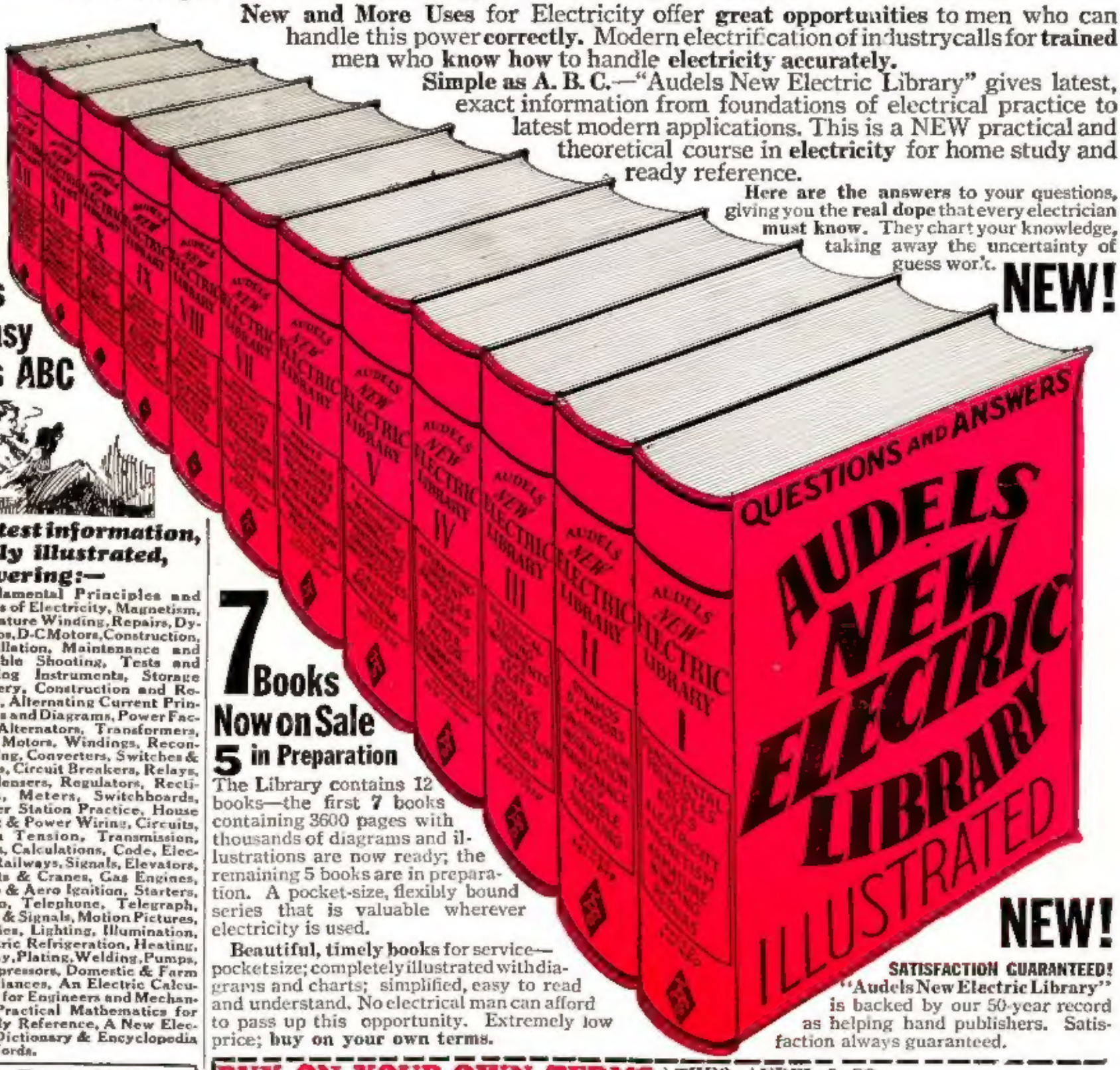

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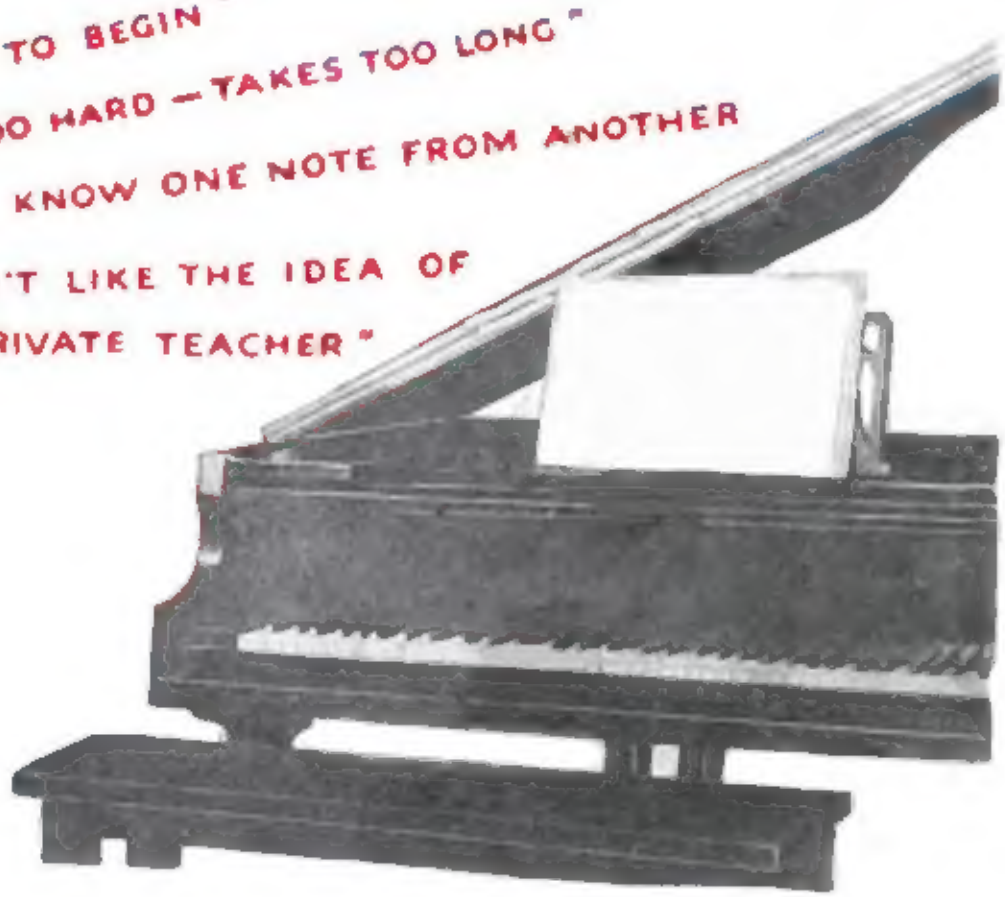

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Name .....

Address .....

City ..... State .....